WATER WORKS & SEWERAGE

THE GREATEST OF THEM ALL

Chicago's 400 M.G.D. Southwest Treatment Works Marks the Close of a Decade of Unprecedented Sewage Treatment Progress.

(It has been dubbed "The Queen Mary of the Prairie")

Copyright, 1940, U. S. Pipe & Foundry Co.

U.S. cast iron PIPE

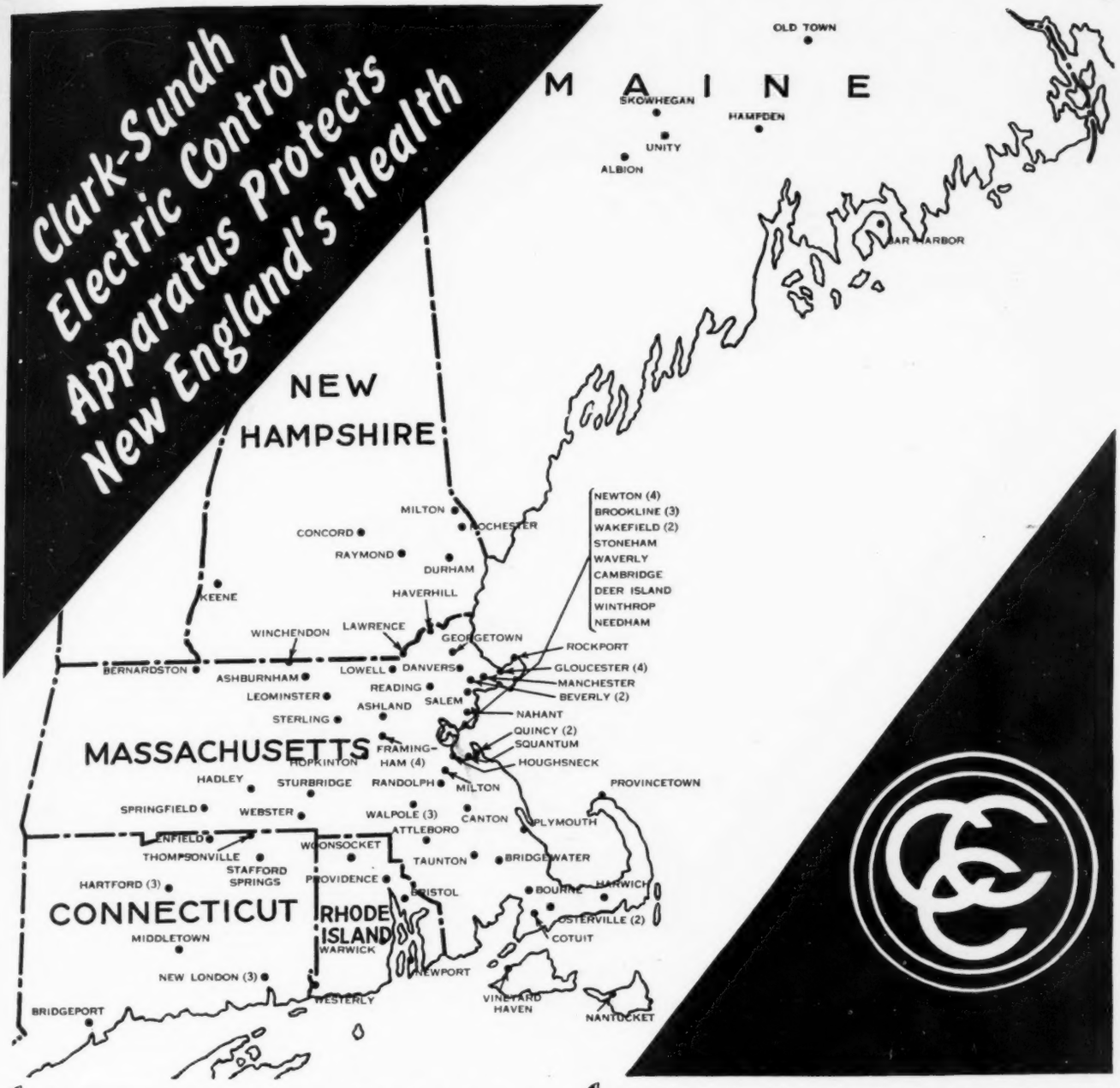
Centrifugally or Pit Cast for water works, gas, sewerage, drainage and industrial services.

U. S. PIPE & FOUNDRY CO.
General Offices, Burlington, N. J.

Plants and Sales Offices throughout the U. S. A.

NO limit can be set to the useful life of cast iron pipe based on performance. The first installation, now nearly three centuries old, is still functioning. Evaluation of service-year costs on the basis of a century of useful life is common practise, and, according to competent authorities, *conservative* practise. Yet this universal acceptance of long life is founded on the history of pipe made long ago, without benefit of the modern methods and metallurgical controls by which U. S. Super-de Lavaud chill-free centrifugally cast pipe and U. S. pit-cast pipe are produced today.

Clark-Sundh Electric Control Apparatus Protects New England's Health



¶ Each municipality shown on this map operates Clark-Sundh Water Works and/or Sewage Treatment Plant control apparatus.

¶ In this thrifty, densely settled New England area, with its diversified industries, an adequate supply of pure water and proper disposal of sewage at all times are essential to healthful living.

¶ Only when Water Works and Sewage Treatment Plants function properly and constantly, is health properly protected.

¶ Clark-Sundh control apparatus, with a long record of dependable operation, constantly provides reliable service—thus safeguarding health in the communities served.

¶ And Clark-Sundh electrical control apparatus is a thrifty buy—simple to install, easily accessible for adjustment, and low in maintenance cost.

¶ "3C" Engineers, trained and experienced in Water Works and Sewage Treatment Plant control problems will gladly consult with you. Our nearest office is at your service.

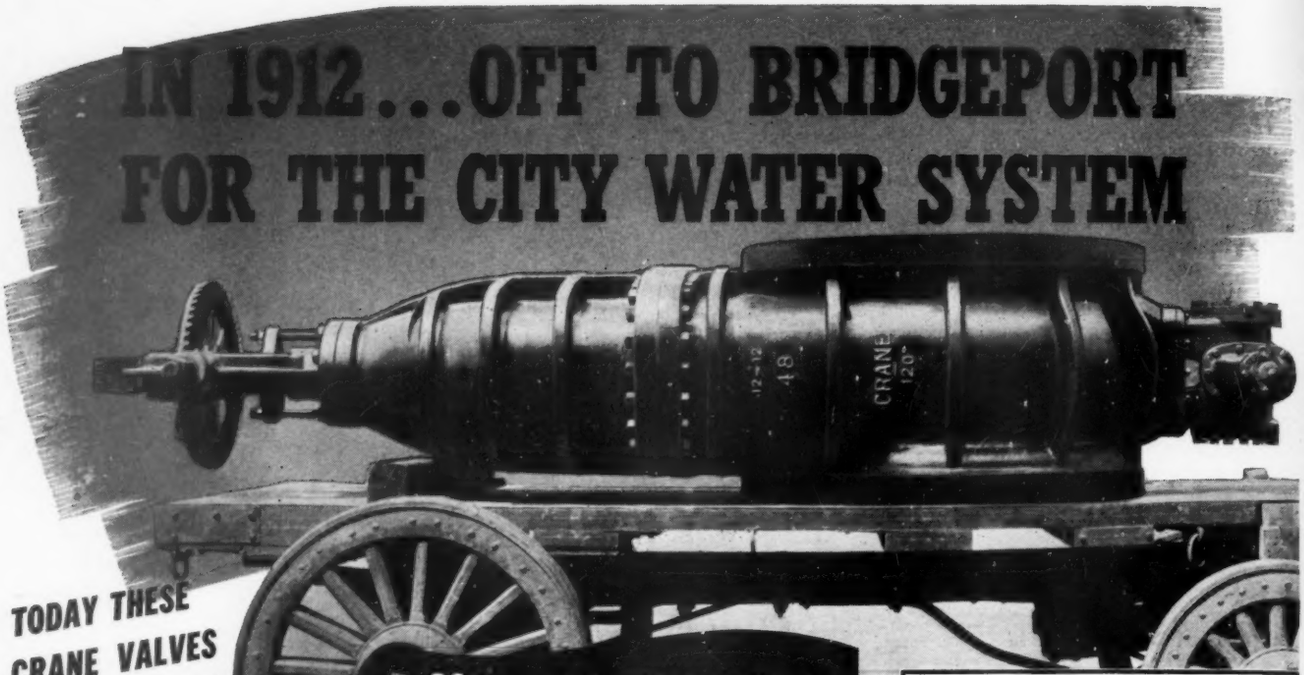
OFFICES IN PRINCIPAL CITIES

THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, OHIO

WATER WORKS & SEWERAGE, February, 1940. Volume 87. Number 2. Published monthly at 330 South Wells Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate, United States and Canada, $2.00 per year; Foreign, $3.00 per year. Copyright, 1940. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under Act of March 3, 1879.

IN 1912...OFF TO BRIDGEPORT FOR THE CITY WATER SYSTEM



TODAY THESE CRANE VALVES ARE STILL GIVING GOOD SERVICE

28 Years of Trouble-Free Service Proves the Economy of *PREVENTIVE MAINTENANCE*

"SINCE 1912 they have given perfect service . . . they are perfectly dependable and reliable." So writes the management of the Bridgeport Hydraulic Company about the 48-inch iron body Crane valves installed in the Bridgeport, Connecticut, water system more than 28 years ago. Except for periodic oiling, they required no maintenance of any kind whatsoever.

Again, Preventive Maintenance speaks for itself—of its sound economy—of the wisdom of choosing valves that are right for the service required—as Bridgeport did back in 1912. For such valves have extra strength and extra resistance to the strains of working conditions; they guard against trouble at the source. Today as then, Crane valves represent the finest development in water control equipment. In design, in the materials for every part, and in manufacture as well—Crane valves are engineered with an eye to the specific needs of each waterworks and sewerage service.

Thus, in the Crane line, there is a valve that is built for Preventive Maintenance at every point in your system—a valve that assures lasting, low-cost performance.

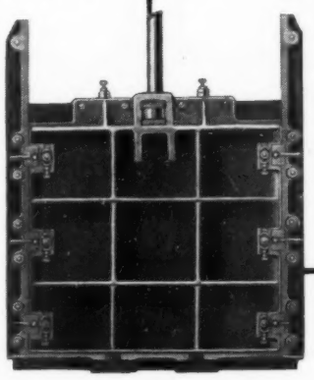
Whether your system is large or small, if you are not applying Preventive Maintenance, you are passing up important money-saving advantages. Talk it over with your Crane Representative.

FOR SEWAGE PLANTS— PREVENTIVE MAINTENANCE COUNSELS CRANE SLUICE GATES

In sewage systems, Preventive Maintenance with Crane Sluice Gates leads to important economy in flow control cost. They're built with the same skill and care as are all Crane valves; in the blueprint stage they take on the extra ruggedness that means longer life and dependability in actual service.

For example, in Crane Sluice Gates there are no rivets or screws to work loose and interfere with operation—or cause burrs that score seating surfaces. Crane seat mounting avoids this danger. The bronze seats are rolled into dovetail grooves of ample section, machined in the disc face. After rolling in, seating surfaces are machined to a smooth finish.

That's just one of many superior features of Crane Sluice Gates. Ask your Crane Representative to tell you all about them.



1940 OUR 85th YEAR

CRANE

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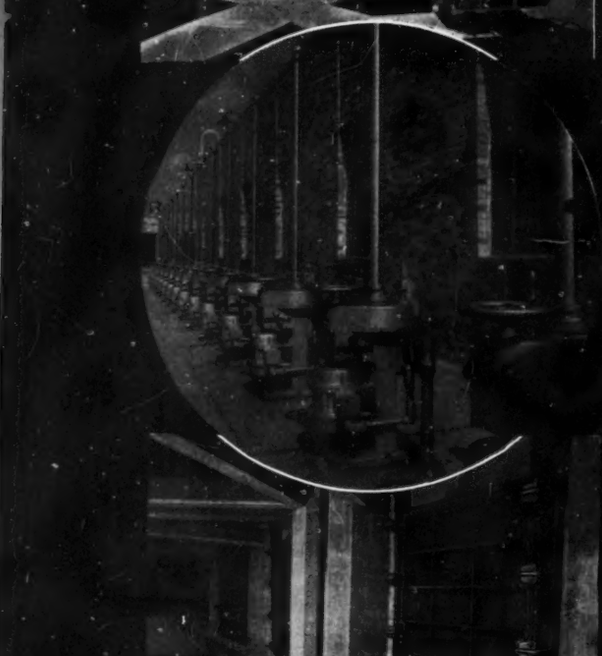
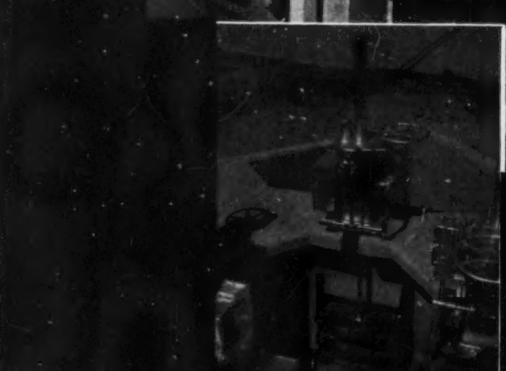
836 S. MICHIGAN AVE., CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

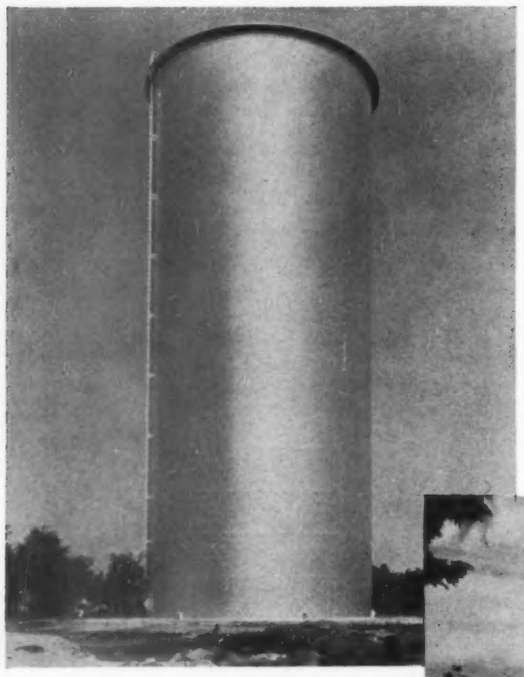




Cleveland — Washington — Minneapolis — Milwaukee — Chicago — Dallas — just a few of the cities where Mueller-Columbian installations have left a record of satisfactory performance year after year.

And of course there is good reason for this. Careful selection and control of materials, extreme ruggedness of design and precise manufacturing methods mean that Mueller-Columbian Equipment will meet every expectation of performance and durability. All Sluice Gates are carefully and accurately machined to templates and gauges which permits ease of installation in the field. Every piece of equipment must meet rigid tests far in excess of actual operating conditions before shipment is made from the plant.

The practical experience of Mueller engineers is yours for the asking. Recommendations, plans and estimates are cheerfully furnished without obligation.

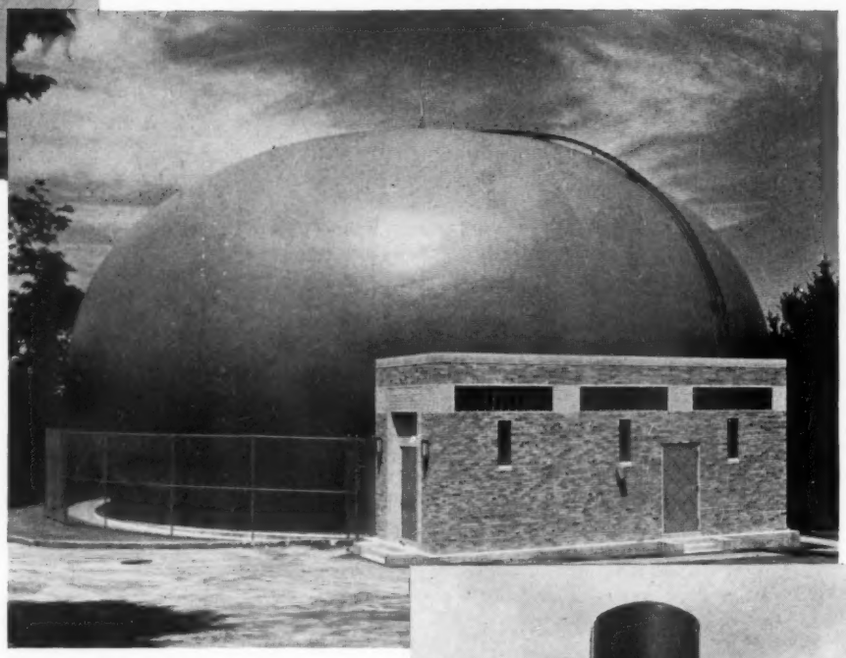


Steel Standpipes and Reservoirs for Water Supply Systems

Left: New welded steel standpipe located at Webster, Mass., used for water storage. It is 41½ ft. in diameter by 100 ft. high.

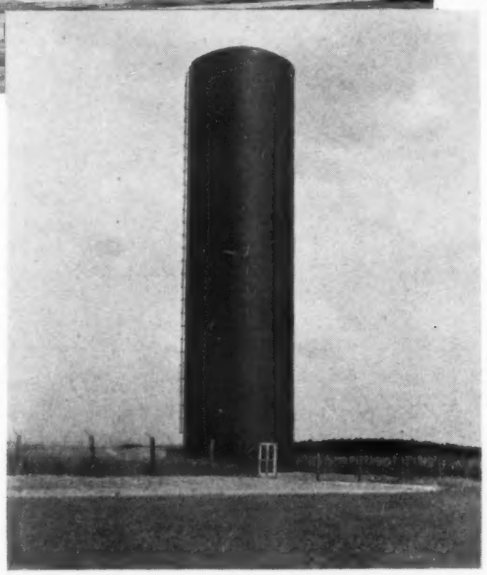
Below: 1,600,000-gal. Hortonspheroid at Brookline, Mass. This is the only structure of its kind ever installed for water storage. It was chosen particularly for its pleasing, modern appearance. This installation is similar to the standard Hortonspheroid used for storing liquids in the oil industry, except that it is not built to withstand internal pressure.

Lower Right: Dallastown and Yoe, Penna., both utilize this 300,000-gal. standpipe, which provides adequate water storage for these two adjacent towns.



PHOSPHORIC PICKLING

The three installations on this page are all of welded construction. The plates used in building all three were pickled by a special phosphoric process which removes the mill scale and leaves a thin coating of iron phosphate on the steel, which is an excellent rust inhibitor, and provides a good bond between the metal and the paint. We will be glad to furnish quotations on the pickling of steel platework for erection at locations served from our Greenville, Pa. plant.



IF you are an operator or designer of water supply systems, you are probably well acquainted with Horton elevated water storage tanks. You may not know, however, that we also build numerous other types of steel storage tanks for service in the waterworks field.

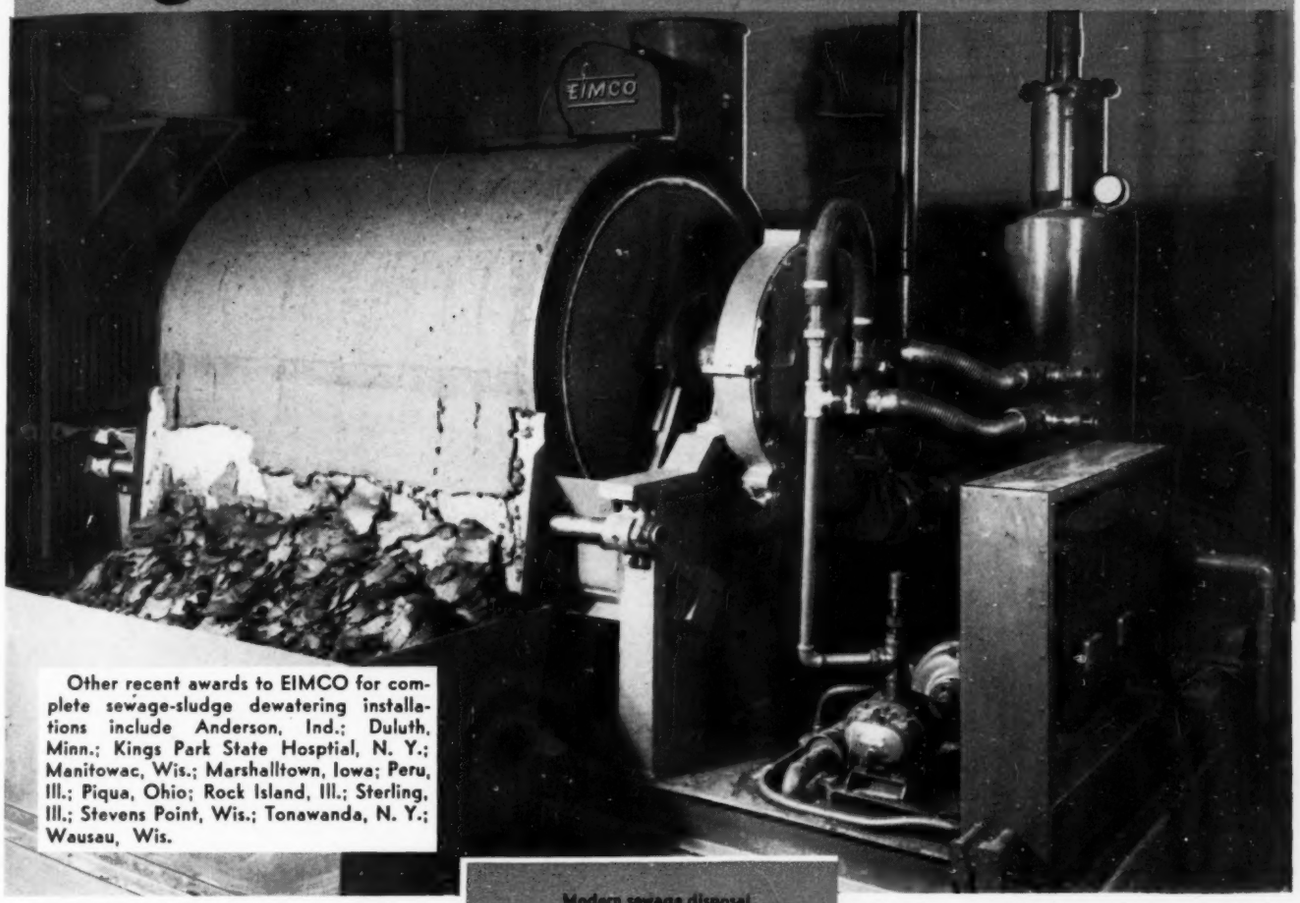
Illustrated on this page are three examples of water storage facilities, other than elevated tanks, that are supplied to meet specific water supply requirements in all parts of the country. In addition to elevated tanks, standpipes, and the Hortonspheroid design shown here, we will be glad to furnish estimating data or quotations on flat-bottom storage tanks, steel reservoirs, welded steel pipe, penstocks, washwater tanks—all these and many "special" designs are available to help you in solving your water supply problems.

CHICAGO BRIDGE & IRON COMPANY

Chicago	2198 Old Colony Bldg.	Birmingham	1586 North 50th Street	Philadelphia	1644-1700 Walnut St. Bldg.
New York	3390-165 Broadway Bldg.	Tulsa	1646 Hunt Bldg.	Boston	1548 Consolidated Gas Bldg.
Cleveland	2262 Rockefeller Bldg.	Houston	2919 Main Street	San Francisco	1083 Rialto Bldg.
Dallas	1479 Liberty Bank Bldg.	Detroit	1551 Lafayette Bldg.	Los Angeles	1455 Wm. Fox Bldg.

Fabricating plants in CHICAGO, BIRMINGHAM, and GREENVILLE, PA.

Another EIMCO Sludge-Dewatering Unit ..begins its service to modern sanitation



Other recent awards to EIMCO for complete sewage-sludge dewatering installations include Anderson, Ind.; Duluth, Minn.; Kings Park State Hosptial, N. Y.; Manitowac, Wis.; Marshalltown, Iowa; Peru, Ill.; Piqua, Ohio; Rock Island, Ill.; Sterling, Ill.; Stevens Point, Wis.; Tonawanda, N. Y.; Wausau, Wis.

Modern sewage disposal plant, Birmingham, Mich.

The City of Birmingham, Mich., has now been added to the rapidly increasing list of communities protected by a modern sewage disposal plant. Engineered by Shoecraft, Drury and McNamee of Ann Arbor, Mich., "contracted" by Banbrook-Gowan Co., of Detroit, and operated by Supt. Stanley Mogelnicki, it represents the last word in sanitary treatment of sewage for a growing city of approximately 10,000 inhabitants.

An outstanding feature is the Eimco Sludge-Dewatering Unit illustrated above, which comprises a 65 sq. ft. continuous vacuum filter with complete vacuum system, lime and ferric-chloride feeders, sludge mix-tanks, etc., all electrically operated. A float-operated remote electric control system automatically assures correct treatment of sludge in proper quantity for efficient flitration. The cake from this filter is practically odorless and sufficiently dry to permit low-cost handling and disposal.

Besides providing the designers of the plant with all necessary data regarding this sludge-dewatering unit, Eimco's experienced filtration engineers checked its installation—thereby relieving the general contractors of all responsibility for its successful operation. No other filter manufacturing company provides such competent engineering service at every stage of design, construction and installation, or assumes such complete responsibility for successful operation under the conditions specified.

Eimco's Sewage-Disposal Engineering Staff is headed by F. E. Kurz and Paul Richter who are located in our Chicago branch office, and are available for consultation on short notice anywhere east of the Rocky Mountains. If you are planning a modern sewage-disposal plant, or preparing to bid on its construction, their recommendations involve no charge or obligation, and may easily help you to achieve very important savings in time and money.

THE EIMCO CORPORATION

634 So. 4th West St.
SALT LAKE CITY, UTAH

333 No. Michigan Ave.
CHICAGO, ILLINOIS

● "Sanitation HTH" is the same dependable, convenient chlorine carrier that has been used successfully for years in water treatment all over the United States. But now it comes in granular form—just as quick and efficient as the old powder form, and more convenient to use. "It pours"—neatly, handily. This dry, free-flowing chlorine carrier, containing 70% available chlorine, is useful for every sort of water treating job—from sterilizing new water mains to disinfecting swimming pool water.

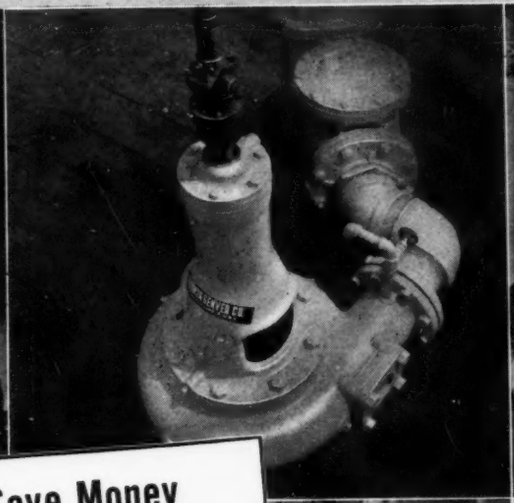
Specify Sanitation HTH and get the "chlorine that pours"!

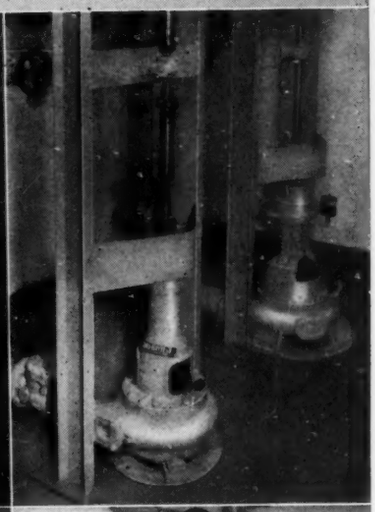
(Sanitation HTH comes in 5-lb. cans with replaceable caps, packed 9 cans to the case; also in 75-lb. drums.)

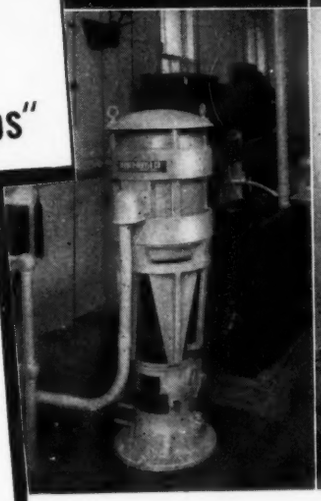
THE MATHIESON ALKALI WORKS (INC.)

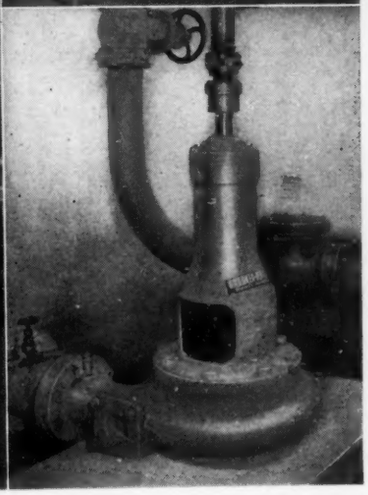
60 East 42nd Street, New York, N. Y.

GOOD NEWS TRAVELS FAST
ABOUT GARDNER-DENVER SEWAGE CENTRIFUGALS!









"Here's How We Save Money with Gardner-Denver Centrifugal Pumps"

An important suburb of New York City is making sizable savings in power costs since installing four Gardner-Denver Non-Clogging Centrifugals. Each of these four Gardner-Denver Centrifugals is installed in a different pumping station. In three of the stations, the Gardner-Denver pumps replace existing pumps which had proved inefficient, and in the fourth station, the Gardner-Denver pump is used for supplementary service. The adaptability of Gardner-Denver Centrifugals to any type of installation is shown by the fact that the pumps had to be installed to fit existing suction and discharge piping—(see photographs).

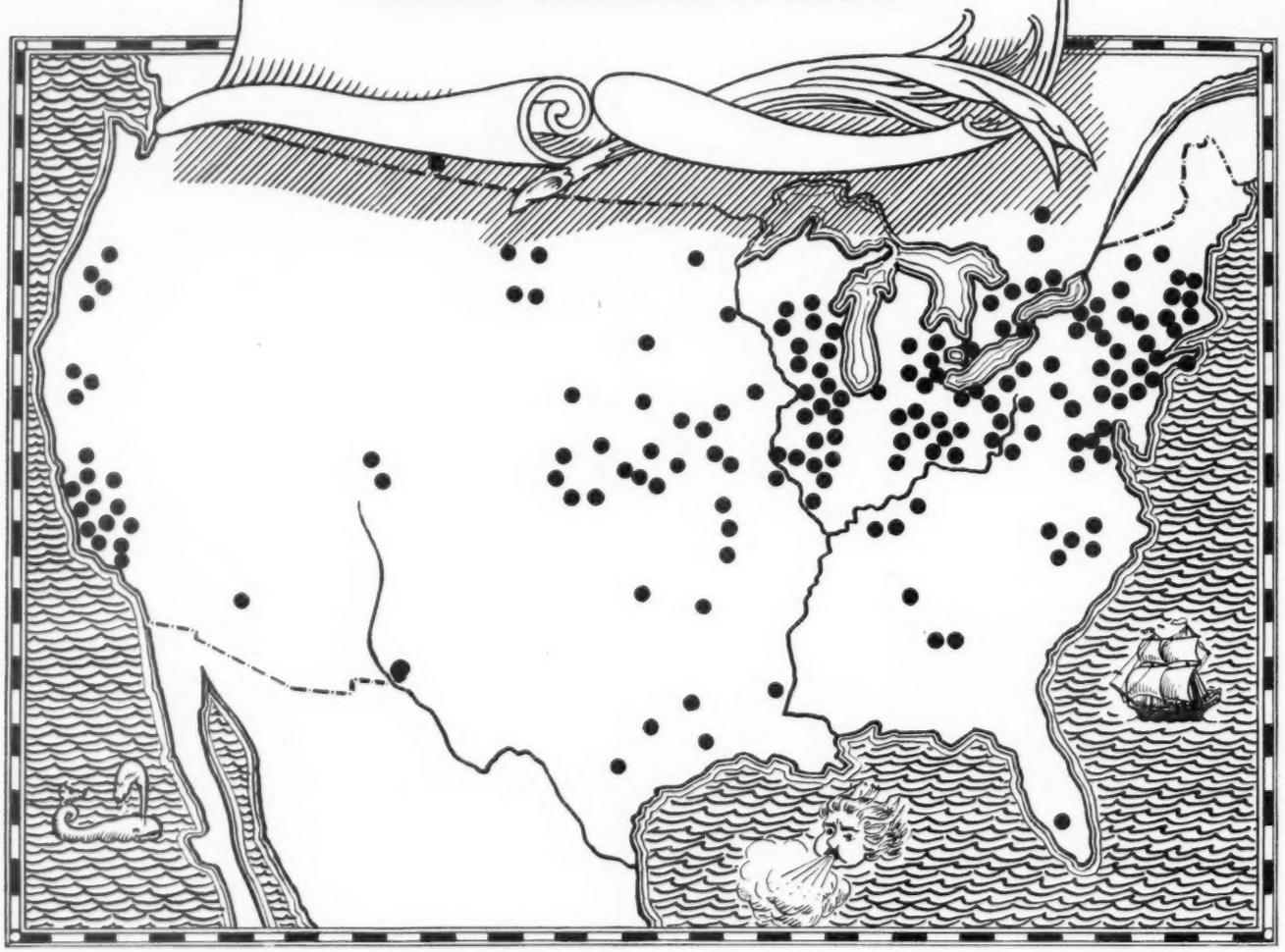
The Gardner-Denver type K Sewage Centrifugals are easily arranged for combination motor and gasoline drives. This combination is recommended to guard against power failures because one unit can be operated entirely independent of the other.

GARDNER-DENVER pump superiority starts with the basic materials . . . augmented by every detail of modern, up-to-date design to provide higher pumping efficiency at lower cost. Bulletin A-303 gives complete information about Gardner-Denver Centrifugals for waterworks and sewerage use. We will be pleased to send a copy! Gardner-Denver Company, Quincy, Illinois.

GARDNER-DENVER
SINCE 1859

ALOXITE BRAND DIFFUSER PLATES AND TUBES

have been the predominant choice among all sewage and water treatment plants on this continent which utilize air diffusion.



THE fact that so many sewage and water treatment plants use Aloxite Brand Diffuser plates and tubes is significant. It means that Aloxite Brand Diffusers have proved their efficiency by performance.

It means that skilled research and experienced engineering service have combined in the production and application of these products of superior quality and proved characteristics.

Write our Sanitary and Filtration Department for information on design, specifications and engineering data on the application of these diffusers in sewage and water plants.

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

REG. U. S. PAT. OFF.

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids

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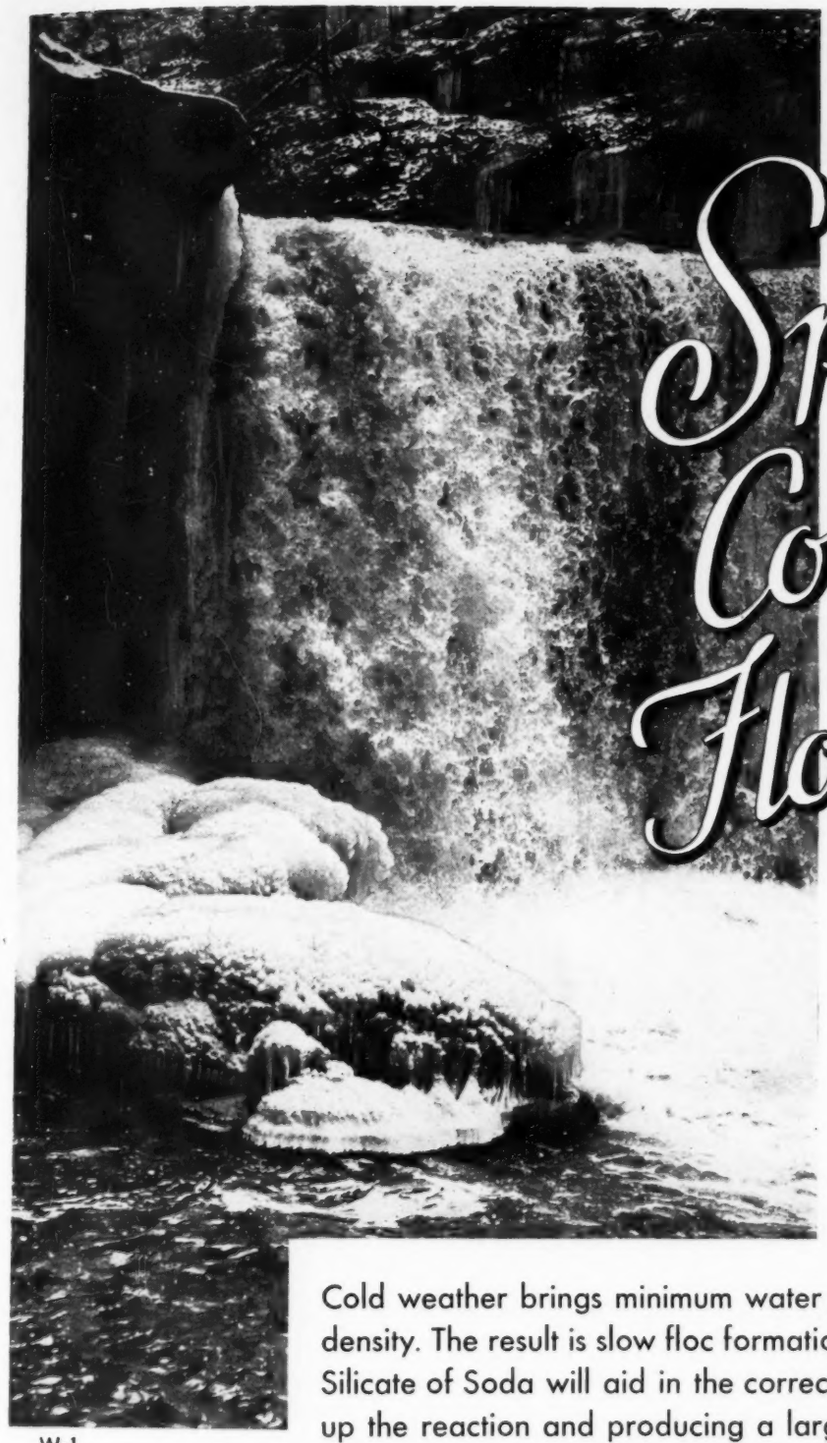


Speed up Cold Water Flocculation

with Standard SILICATE OF SODA

Cold weather brings minimum water temperatures and maximum water density. The result is slow floc formation and settling. The use of Standard Silicate of Soda will aid in the correction of both conditions by speeding up the reaction and producing a larger, denser floc. As a result, longer filter runs are possible and substantial savings can be affected in chemical consumption.

Let our technical staff help you adapt this process to your plant!

W-1

DIAMOND ALKALI COMPANY

STANDARD SILICATE DIVISION

General Offices · PITTSBURGH, PA.

Plants at Cincinnati · Jersey City · Lockport, N. Y. · Marseilles, Ill.

What comes under the head of

LEAKAGE?

The answer is *leakage*—nothing else. *Not* water used by the fire department and the sewer department, nor water for street flushing, main flushing, fountains and public buildings. These and other uses and losses properly come under the head of *unaccounted-for water*, estimated to total about *15% of normal consumption.* Some—not all—is due to leakage from mains.

* * * *

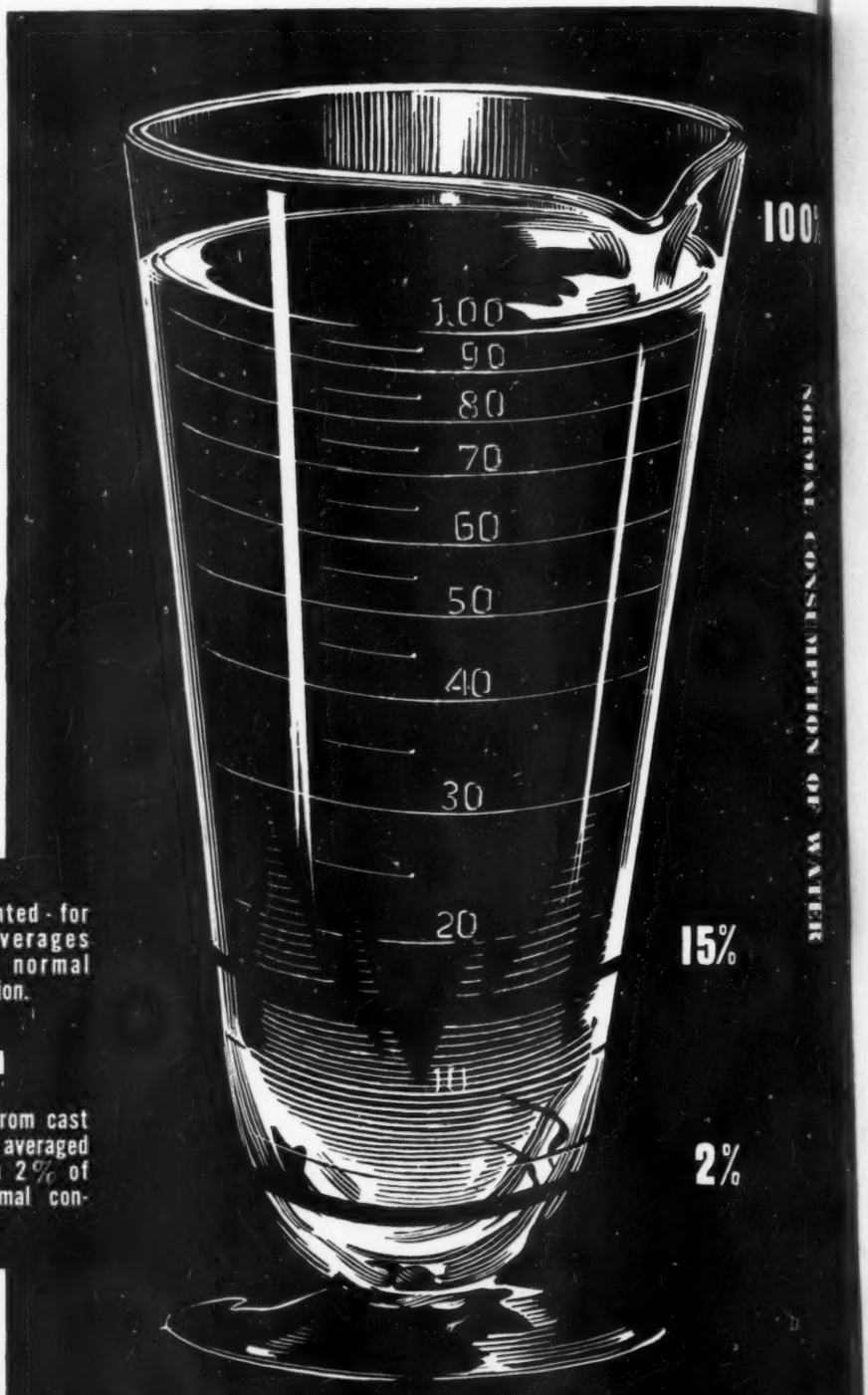
To ascertain how much of the 15% average of unaccounted-for water is actually due to leakage from water mains, we have recently conducted a leakage test survey of cast iron mains in 25 cities in various states. The mains tested range from several hundred feet to more than twenty miles in length, in sizes from 4″ to 30″ and up to 44 years old, either with no service connections or relatively few that were turned off during the tests. The average leakage per mile of pipe, per inch of diameter, per 24 hours was 41 gallons—or an average of 380 gallons per mile of pipe per day for the sizes tested. This leakage is less than 2% of the average of normal consumption per mile of distribution main per day. This survey, covering a broad average of water main construction and substituting facts for guesswork, shows that

less than one-tenth of all unaccounted-for water is due to leakage from cast iron water mains.

For further information write to The Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, 1015 Peoples Gas Bldg., Chicago, Ill.

CAST IRON

Look for the "Q-Check" registered trade mark. Cast iron pipe is made in diameters from 1¼ to 84 inches.



WATER WORKS & SEWERAGE

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E. S. Gillette, Publisher

EDITORIAL OFFICE
155 East 44th Street, New York, N. Y.
L. H. Enslow, Editor

COMING!

Are You Watching Your "C" Line?

Is a discussion of the worth of keeping a track on the internal condition of arterial mains and the distribution system, and methods of doing so. The author contributes useful tables and graphs developed by himself for the purpose of avoiding arduous computations in determining friction coefficients ("C" in the Hazen-Williams formula) with sufficient accuracy for interim check-ups on the condition of mains and how the trend is going. The author stresses the worth of "Watching Your 'C' Line" and presents examples to illustrate use of the tables and graphs which he has found so helpful. The author—

D. R. TAYLOR, Plant Sup't.
Roanoke, Va.

Treating Industrial Wastes

Constitutes Part 2 of the annual review by Dr. F. W. Mohlman — "Developments and Trends in Sewage and Waste Treatment"— Part 1 of which is featured in this issue.

The Filtration Plant of Milwaukee

Is America's newest major filter plant. Its several novel features and innovations are to be described by the man who has many years fought to secure this plant for his City. What has been learned during the first year of operation will add materially to the article by—

J. P. SCHWADA, City Engineer
Milwauke, Wisc.

Packing Plant Waste Treatment

The method and plant of an important meat packing establishment involves multiple stage filtration. An innovation is the primary high-rate roughing (decolloidizing) filter, which is equipped for air and liquid back washing. Performance records add interest to the newness of the design and the method. The author—

L. R. HOWSON, Consulting Engr.
Chicago, Ill.

Weed Control in Reservoirs

Was the subject of an interesting article in our July 1938 issue. The scheme, which from all subsequent reports has proved very effective, involves the use of a chlorinated hydro-carbon which sinks into the mud to poison the actual root growth of weeds. The question of what effect such treatment might have in imparting an aromatic odor or a taste to reservoir waters used for public supplies was immediately raised. Subsequent studies have been made to answer this important question. The results of such studies are presented in an article by—

MORTIMER GIBBONS, Supervising Chemist
Water Department, Rahway, N. J.

The Treatment Plant of Lake George, N. Y.

Has some features of unusual interest. One in particular is the author's novel design of sludge compartments for the final settling tanks. A triple prism, hopper, with steep slopes, provides positive and constant sludge movement to the discharge pipe; also maximum sludge concentration with minimum retention required for sludge depth building. The author—

MORRELL VROOMAN, JR., Consulting Engr.
Gloversville, N. Y.

"25 Signs of the Master Salesman"

Is an article by a "Master Salesman" which reveals his conception of what "Master Salesmen" are made of. We have purposely scheduled this article for the benefit of the many salesmen who admit that they do "glance through" *Water Works and Sewerage*. The Author—

J. G. FREDERICK
New York City

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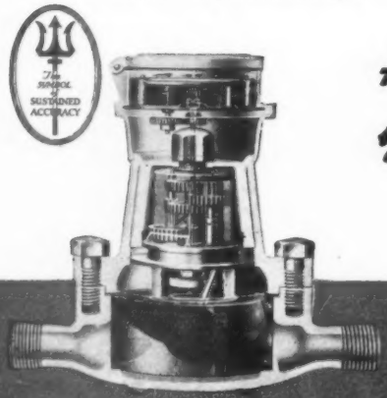
THE *New* THRUST ROLLER BEARING PLATE

STANDARD
on the new
INTERCHANGEABLE
to fit your old

Trident DISC METERS

WHY let the measuring chamber—a very accurately machined piece of mechanism—take any wear which can possibly be avoided? In new Trident meters, the problem of wear caused by the action of the thrust roller has been solved, simply and efficiently, with a thrust roller bearing plate.

Ask us about modernizing your old Trident chambers



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Neptune Meters, Ltd., 345 Sorauren Avenue, Toronto, Canada

WATER WORKS & SEWERAGE

VOL. 87, NO. 2 *A Gillette Publication* FEBRUARY, 1940

THE DISPOSAL OF SEWAGE AND INDUSTRIAL WASTES DEVELOPMENTS AND TRENDS IN 1939

By F. W. MOHLMAN

Director of Laboratories, Sanitary District of Chicago
(Editor, Sewage Works Journal)

PART 1—SEWAGE*

PROGRESS in sewage treatment practice is accomplished to a major extent by the development of new equipment which is more efficient, more economical, or more cleanly than that in current use. Outwardly we see the evidence of progress in new types of grit chambers, grit washing devices, grease separators, screenings comminutors, flocculators, sedimentation tanks, aeration tanks, effluent strainers, sludge filters, incinerators, and gadgets too numerous to mention. But, behind these visible evidences of progress we see the principles and the columns of data that made it possible to design such equipment.

The Author

Research, impartial and searching, is the safest basis for the development of new equipment in sewage treatment. It is fortunate that the leading American manufacturers recognize this fact, and that they introduce new equipment or processes only after practice has shown the need for something new, and research has shown how to make it.

This conception of research is far from academic. An operator of a small sewage treatment plant may develop an idea which will advance the art of sewage treatment as truly as those more grandiose schemes born and nurtured in research laboratories or in large and complicated treatment plants. In a review of progress, therefore, we must look for the significant developments, whether they be large or small, which promise to improve and extend the efficiency, economy or cleanliness of sewage treatment.

*Part 2—Devoted to progress and trends in treatment of industrial wastes alone or in combination with domestic sewage, will follow in the March issue.—Ed.

What Is New?

The year 1939 ended the thirties, a decade without parallel in the development of processes and equipment, and in the construction of new and large treatment works. Ten years ago the decade of the twenties closed with the accomplishments of heated digestion, standardization of activated sludge design, use of glass-covered sludge drying beds, filtration of activated sludge, and widespread use of chlorine. Inhoff tanks and trickling filers were waning, and fine screens were rarely installed. The inflation of 1928-29 was not reflected in any notable increase in construction of new sewage treatment works.

Then came deflation and the cessation of practically all construction for four or five years. During these years, however, the ferments of new ideas seemed to work more intensely; research and experimentation flourished; and the seeds of progress that were slowly germinating burst into fruition when nurtured with the beneficent rain of PWA loans and grants and WPA grants. Sewage plants grew as never before, and new equipment, new chemicals and new processes were introduced everywhere. Chemical treatment staged an exciting come-back; mechanical filters for both sewage and sludge were introduced; gas was used more and more widely; digested sludge was elutriated and filtered on vacuum filters; multi-hearth incinerators and flash-dryers were developed; high-rate trickling filters commanded interest; activated sludge research focused attention on air requirements and operating economies; garbage was ground and discharged into sewers; the use of dried sludge as fertilizer was extended; and colossal chlorination plants were installed in some of the large treatment works.

Probably the most colorful episode of this era was the intense interest in chemical treatment of sewage, marked by the rise and fall of numerous chemical processes, and culminating in the survival of the simpler yet more rational combinations of chemicals, used seasonally or at times of deficient dilution.

The thirties were interesting years, and 1939 closes a decade of great progress in the science of sewage treatment. What was new in the last year of this decade?

Clarification

Clarification has been improved by use of flocculators with or without chemicals to improve sedimentation, the use of magnetite and sand filters following sedimentation, and the use of chemicals with or without effluent filters.

Flocculation

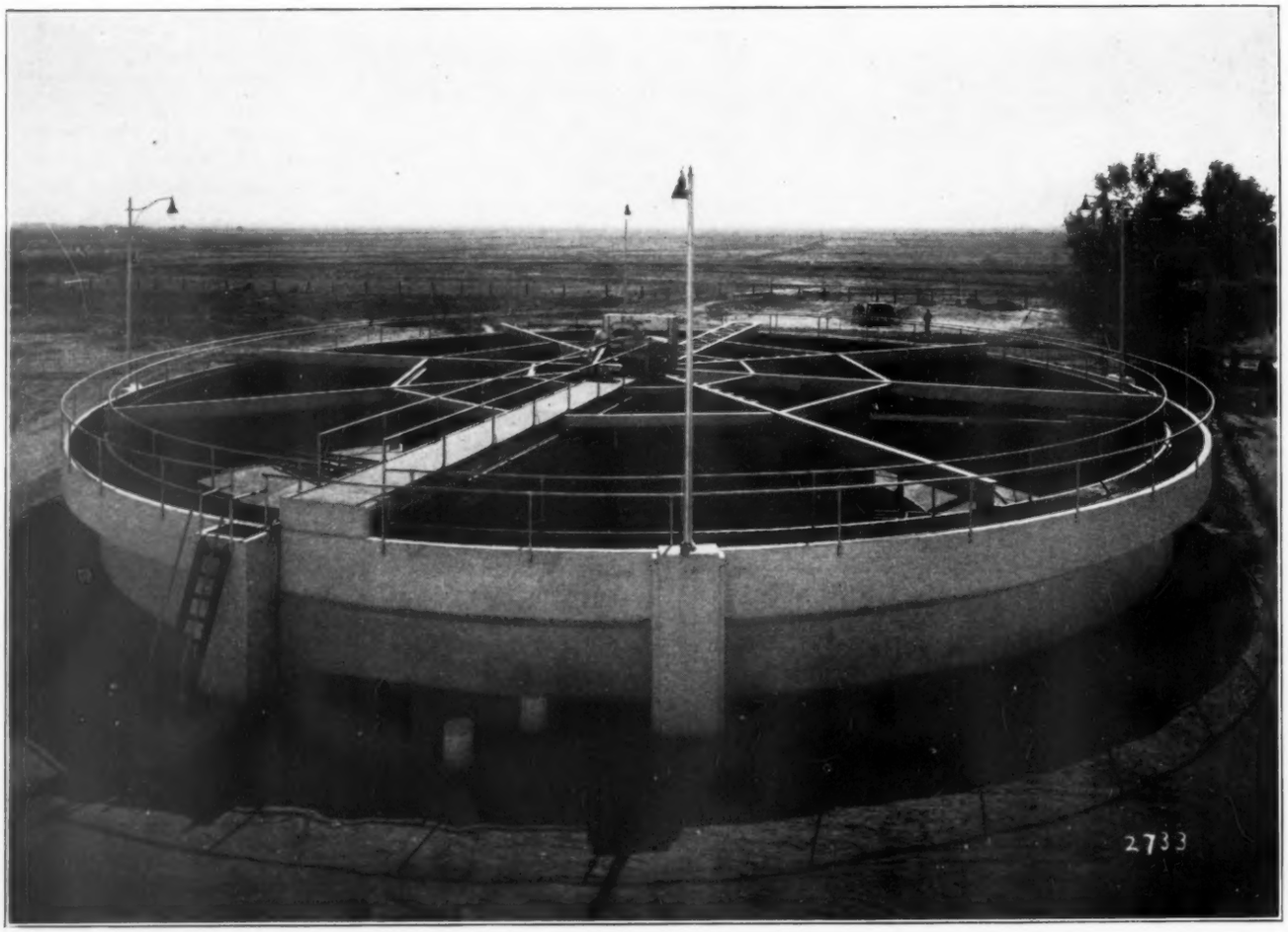
Flocculation without chemicals has had wide study in 1939, and in most cases, particularly with strong sewage, substantial increase in removal of suspended solids has been accomplished. Cedar Rapids reports the most striking results, followed by the new Richmond-Sunset plant at San Francisco, air flocculation at Minneapolis, paddle wheels experimentally at Chicago and Los Angeles, and full-scale tests of a combination clarifier and flocculator at Ypsilanti, Mich. Dr. A. J. Fischer spent a good part of 1939 rounding up data on this subject, and has reported up to 23 per cent increase in removal of suspended solids, based on controlled tests. At Waukegan plain flocculation accounted for an increased removal of about 20 p.p.m. from a sewage containing 237 p.p.m. suspended solids. On a weak sewage at the Chicago West Side experimental plant, the additional removal by plain flocculation was 13 p.p.m. (86 to 73) from a raw sewage containing 131 p.p.m. The efficiency of flocculation varies with the strength, and most likely with the CO_2 to HCO_3 ratio of the sewage. The presence of industrial wastes containing lime, iron or other metal salts will improve flocculation.

In addition to the aspect of increased removals of solids, the higher rate of settling of flocculated solids results in the possibility of using shorter periods of sedimentation, thus offsetting the cost of flocculators as an item in the capital charges on treatment works. It is surprising, but true, that in most cases a period of flocculation of 30 minutes shows a definitely increased removal of suspended solids and B.O.D., as compared with periods of even as much as 20 minutes. One may therefore doubt that pre-aeration for only a few minutes has any significant flocculating action.

When chemicals are used, mechanical flocculation is indispensable. "Bio-flocculation," as in the Guggenheim process, means apparently a longer period (45 minutes or more) plus return of sludge and the assistance of chemicals. Possibly "bio-flocculation" is a factor in the results obtained by paddle-wheel flocculation after 20 or 30 minutes, aided by absorption of oxygen at the surface.

Magnetite Filters

Large installations of magnetite filters at Minneapolis and Denver have been under study for a year or more. A fairly large experimental plant was also operated by the Sanitary District of Chicago in 1938 and 1939. Three

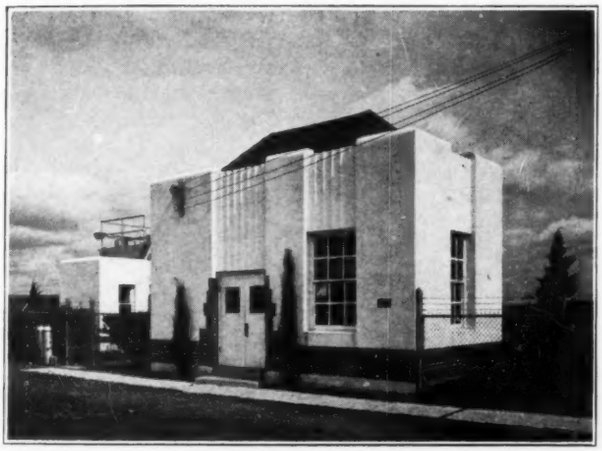


Dorr "Clari-Flocculator" at Bakersfield, Calif. This 100 ft. diameter unit is the largest yet installed.

units were installed at the Cleveland Southerly Works for straining trickling filter effluent, and for the same purpose small units have been installed at Atlanta, Ga., and Plainfield, N. J. The latter are of the up-flow design. At Greece, N. Y., units have been installed on the final clarifiers of a small activated sludge plant, apparently for the purpose of permitting greater air economy with less danger of sludge carry-over in the effluent, during peak flow periods.

As compared with control settling tanks with the same settling period, magnetite filters have removed from 12 to 30 p.p.m. more suspended solids and 8 to 20 p.p.m. more B.O.D. The relative percentages of removal depend upon the strength of the raw sewage and the ratio of settleable to colloidal solids, or the degree of flocculation. One of the advantages claimed for magnetite filters is that the settling period may be shortened with safety, reliance being placed upon the filters for interception of suspended solids. This is particularly true with flocculated solids such as those from chemical precipitation, trickling filters or in activated sludge effluents.

Two types of magnetite filters have been installed (1) downward flow, straight-line units with shuttle-type cleaning mechanisms, and (2) upward flow, peripheral magnetite beds in circular tanks, with uni-directional revolving cleaning mechanism. The down-flow type has been used in the larger installations mentioned above. Considerable work has been done to prevent disturbance of the magnetite at the entrance ports, and to prevent

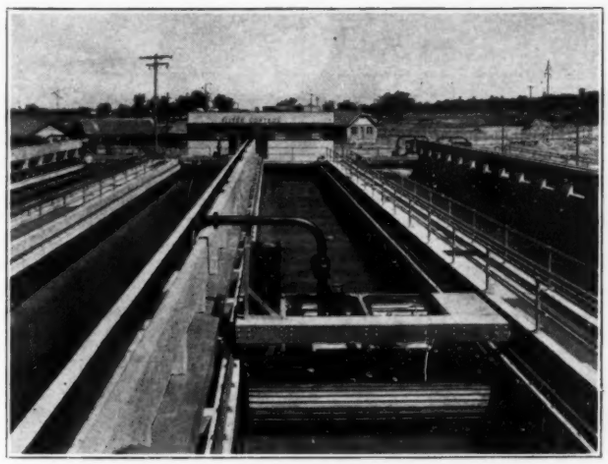


W.P.A. Project Plant of Rayne, La., illustrates the effective use of architectural concrete in small plants recently.

accumulations of fine sand or magnetite below the screens on which the filtering bed rests. Study has also been necessary to indicate results that can be obtained under practical operating conditions at rates higher than the normal rate of 3 gals. per minute per square foot of filter area.

The peripheral (upward-flow) filter has been installed at smaller plants, and apparently it has been free from some of the hydraulic problems encountered with the downward flow type constructed outside of the settling unit. A more recent development has been the self cleansing downflow sand filter.

The magnetite filter has been one of the most versatile types of apparatus introduced into the sewage field in the past few years; it reflects credit on Mr. W. C. Laughlin, its inventor, for his foresight in using magnetite sand, cleanable by electro-magnets. An important factor in the acceptance and wide adaptation of the magnetite filter has been the work of Mr. S. I. Zack in accumulating,



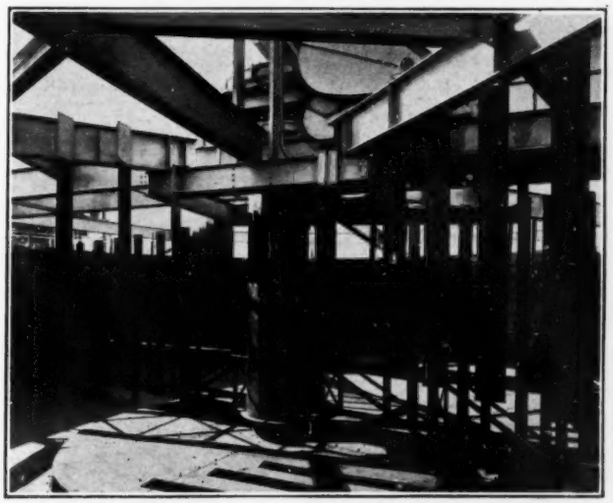
Magnetite Filters at the New Denver Plant.—Minneapolis and Cleveland have the same downward-flow type.

analyzing and disseminating the kind of information engineers and chemists want in evaluating the performance of new equipment. Again, research on the practical side has proved worthwhile in the rise of the magnetite filter.

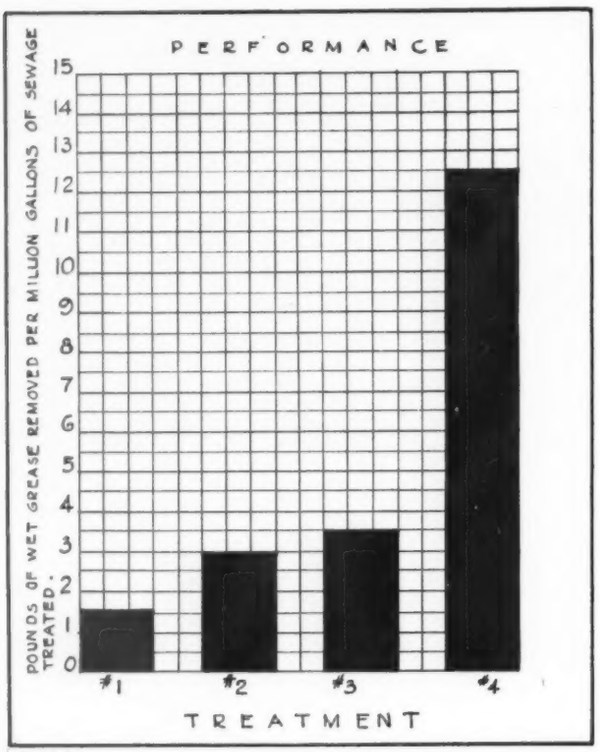
Chemicals—New and Old

Chemicals for flocculation of sewage loom as a fertile field for patent-avid promoters, but occasionally new possibilities appear, usually those developed by competent investigators. Among them may be mentioned the Guggenheim procedure developed for making ferric sulfate from ferrous sulfate plus sulfur dioxide. This procedure was tried out at the Chicago experimental plant, and found to be as effective as claimed. The SO_2 must be diluted with air and some time is required to complete the reaction; but, allowed a sufficient period, the conversion is almost complete. This process, however, can be used only at the treatment works—i.e., at the point of production.

Alum and sodium silicate have been used for sewage flocculation. This combination was first developed by Mr. John Baylis, of Chicago, for use in water flocculation, and, was first reported in this magazine, of which Mr. Baylis has long been a contributing editor. The sodium silicate greatly accelerates formation of floc and, most importantly, toughens it. This combination has been used at several sewage treatment plants, particularly at Wau-



The Mechanism in the Central Cylinder of the "Clari-Flocculator"



The Effects of "Aero-Chlorination" at Lancaster, Penn., on Grease Separation in the Primary Tanks. From plant scale tests.

kegan, Ill., where it was used during the summer of 1939. The results compared favorably with those from ferric chloride employed during the previous summer. Although the appearance of the effluent was noticeably improved, no improvement was actually noted in analytical results during ferric chloride treatment. The cost of the alum-silica might be slightly less than ferric chloride if the labor costs of activating the sodium silicate were less. Sulfuric acid must be added to the alkaline sodium silicate to reduce it to a definite alkalinity, and then the solution must be aged for several hours. Care is essential to prevent overtreatment and jelling of the silicate; and, again, the silicate activation must be done at the point of use.

This combination was also tried out at the Grand Forks, N. D., plant by Lavine and Christensen, but their data are rather limited.

A long trial of ferrous sulfate plus sodium silicate was made at the Chicago experimental plant. Mr. E. Hurwitz, chemist, found that, on the weak Chicago sewage, the much cheaper ferrous sulfate could be used instead of alum. Oxidation to ferric sulfate was unnecessary before application, and definite improvement with the use of activated silica was demonstrated. The average quantities of chemicals involved were 120 lb. copperas ($FeSO_4 7H_2O$), 120 lb. sodium silicate (42 deg. Bé.), and 15 lb. sulfuric acid (66 deg. Bé.) per million gallons.

It is reported that the so-called "activated alum" has been used at Ridgewood, N. J., Greensboro, N. C., and elsewhere; and ordinary filter alum alone at Colorado Springs and Danville, Ill. Mr. R. W. Ockershausen, of the General Chemical Company, has supervised tests and collected considerable information on the use of alum for flocculation of sewage.

These new chemicals, or others, may make their way into the sewage field, but for the present the preferred chemicals for flocculation of sewage are chlorinated-copperas (which is ordinary ferrous sulphate oxidized with chlorine), ferric sulfate, and ferric chloride—the latter being purchased as such in liquid, crystal or anhydrous form; or produced at the point of use from scrap iron and liquid chlorine by employing the Scott-Darcey Process, which has recently undergone further development.

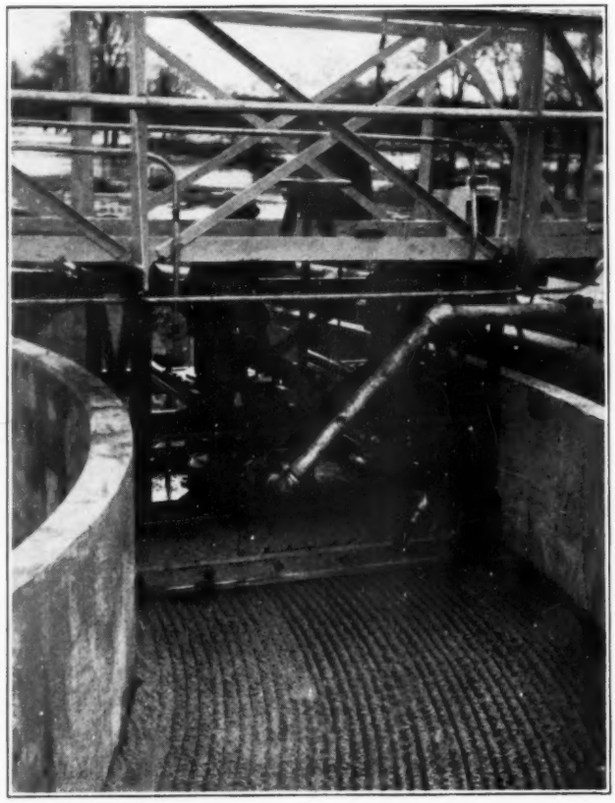
For conditioning of sludge preparatory to filtration ferric chloride remains pre-eminent.

Grease and Scum Removal

The use of chlorine for increasing the separation of grease and scum is an interesting development. Most of the data has been derived at Lancaster and Baltimore. At the former plant, Mr. Gordon Wiest reported the following data, each period being one week:

Period	1	2	3
Chlorine (p.p.m.)	0	0	2
Air (cu. ft./gal.)	0	0.14	0.14
Wet grease (lb./m.g.)	1.6	3.0	12.5
Dry basis (lb./m.g.)	0.2	0.5	1.9

This increase is not very impressive, when computed to parts per million, but, Frank L. Flood has observed that the analyses of influents and effluents indicate a removal of grease in the primary sludge of 8, 13 and 17 p.p.m., respectively, for the three periods. Thus there can be accounted for an apparent removal of 67, 108 and 141 lb. per million gallons—a substantial amount. Analyses of the sludge, however, should be checked to see whether such large removals can be confirmed.



Automatically Cleaned Down-flow Sand Filter in Circular Clarifier. — South River, N. J., Chemical Precipitation Plant.

The Baltimore data were reported in 1938, and indicated a large percentage increase in weight of grease bearing scum removed.

Probably the most helpful feature of pre-chlorination for grease removal is in the improvement of the appearance of the effluent or the surface of the aeration tanks, rather than in actual dry weight of scum removed. For instance, a few parts per million of screenings lying around screen chambers can ruin a plant's reputation in the opinion of a visitor, even though the settling tanks may be doing a good job. Comminutors, grinders, and other equipment have been devised merely to alleviate this sore spot in a plant's appearance. If a small amount of chlorine, in addition to its primary purpose of complete or partial disinfection, or odor control, can materially improve the appearance of the tanks or effluent, its usefulness will be extended and the scope of its application will again be widened. [At Lancaster it is Mr. Weist's opinion that aero-chlorination has been an effective remedy to sludge bulking, whether due to grease separation in the primary tanks or to some more obscure cause.—Ed.]

Further research on scum and grease removal is well worthwhile. Studies are being undertaken by Mr. Daniel Okun, one of the writer's students in the graduate school of Armour Institute in Chicago.

The new Dallas plant is to include four minutes of plain aeration plus four minutes of "aero-chlorination" in an enclosed building, ventilated into a spray tower supplied with plain or chlorinated water at will.

Pre-Chlorination

Addition of chlorine ahead of primary settling tanks is now standard practice, founded upon the information collected in past years by Linn Enslow, of the Chlorine Institute, which demonstrated that ounces of pre-chlorination were worth pounds of post-chlorination, thus again showing the common sense of prophylaxis. The large chlorine installations at Buffalo, Coney Island, Detroit and Minneapolis, and smaller ones at Austin, Minn., Fargo, Dallas and Austin, Texas, and Rahway, N. J., provide for pre-chlorination. At Detroit, Morrill suggests that "It may even prove economical to pre-chlorinate at points in the interceptor system." This has been done for years in California and Texas cities and one or two Eastern cities, but would be new in the northern part of the United States.

Chemical Treatment

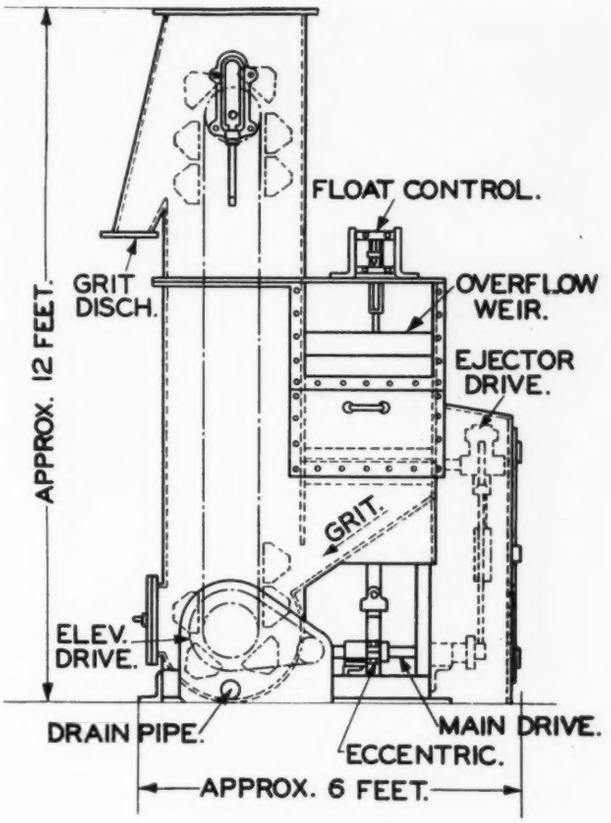
New chemical processes are not so plentiful as they were a few years ago. The Guggenheim process at New Britain still evokes great interest. There, considerably improved results were reported in 1939 by use of a little more iron and improved operating control. The essential comparative data are shown below:

Guggenheim Process at New Britain, Conn.

Results in Parts per Million

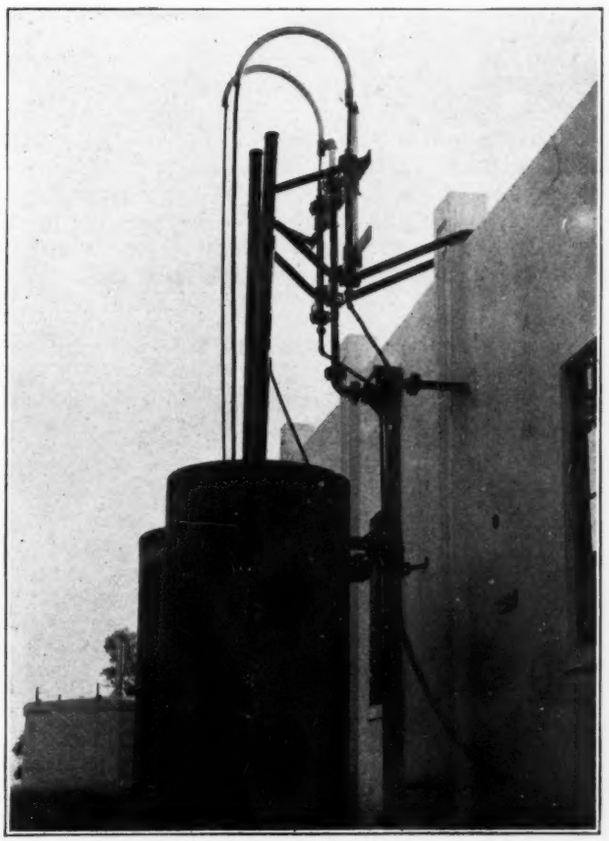
Month	Iron as PPM.Fe		—5 Day B.O.D.— Raw		Effluent		—Suspended Solids— Raw		Effluent	
	1938	1939	1938	1939	1938	1939	1938	1939	1938	1939
Feb.	2.9	4.5	121	164	29	13	132	157	28	6
Mch.	3.9	4.2	145	138	37	13	144	138	30	10
Apr.	5.0	3.1	138	140	37	12	166	140	29	8
May	5.1	5.3	116	173	35	18	161	166	31	12

Evidently the improved results reported in April and May, 1939, cannot be due to any increase in the amount



The Jeffrey "Gigrit"

A new grit washing machine that came out on the market in 1939. Largest installation is at N. Y. City's Bowery Bay Plant.



A W. & T. Scott-Darcey Installation at a Small Plant in Arizona. Produces ferric or ferrous chloride at will from scrap iron and chlorine.

Detroit's 27 Ton Chlorinator Installation Is Nothing Short of Colossal

(Nine W. & T. machines of 6000 lbs. capacity, each, make this 1939 installation the world's largest. Next comes Buffalo with its 15 ton/day capacity.)

of iron, because the dosages involved average about the same for both years. No very satisfactory explanation has been given to account for the differences in 1938 and 1939 results.

The Guggenheim Process was installed at Anderson, Ind., in 1939, and the plant may be in operation by this time. Howson, reporting on treatment for Gary, gave the following estimates:

Type of Treatment	Cost	Annual Cost
Trickling Filters	$1,948,000	$ 99,220
Chem. Pptn. & Tr. Filters	1,760,000	119,350
Activated Sludge	1,926,000	128,665
Guggenheim Process	2,112,000	138,230

An activated sludge plant is now under construction.

Activated Sludge

The Southwest Works of The Sanitary District of Chicago was started in July, 1939. This is the largest activated sludge plant in the world and it completes the vast sewage treatment program of the District, except for final treatment of the Imhoff effluent from the West Side Works.

The Southwest Plant has a nominal capacity of 400 m.g.d., but this can be increased to 500 m.g.d. merely by adding final settling tanks, as experiments indicate that the normal aeration period of 5.0 hours may be shortened to 3.4 hours with hardly any measurable loss in efficiency. The sludge handling equipment at the Southwest Works is designed to receive all of the sludge from the North Side Works, in which 200 m.g.d. is treated.

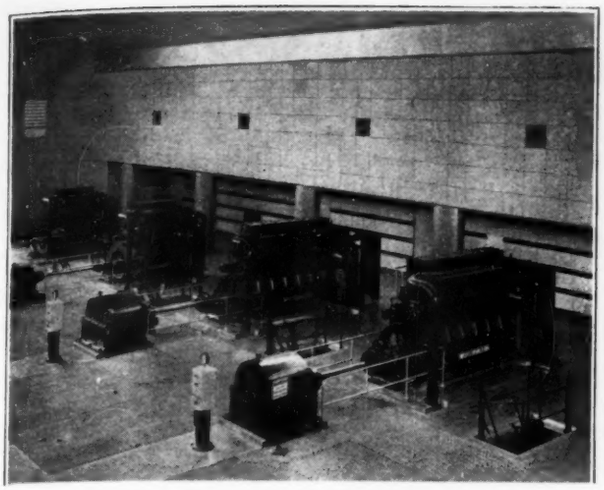
Activated sludge treatment at Chicago has had the benefit of many years of development. When the writer came to Chicago in 1919 the Des Plaines River Treatment Works was being designed. It was designed like a testing station, with virtually four plants operating in parallel, in order to study depth of aeration tanks, reaeration of sludge, hopper bottom vs. mechanically cleaned settling tanks, and filtration of sludge. The Calumet Works, originally an Imhoff plant put into operation in 1924, contained two large activated sludge units, one with pre-settling, one without. This entire plant was abandoned in 1937 when the new activated sludge plant was completed. The North Side activated sludge plant was opened in 1928, and it too has served as a colossal testing station to study aeration periods, reaeration of sludge, width of aeration tanks, and ratio of diffuser plates. Thus there was plenty of precedent for the design of the Southwest Works. Some new factors are present in this plant because of the presence of packinghouse and stockyards wastes. About 40 per cent of packingtown is now tributary to the plant, and the remainder will be received during the present year. These wastes will bring in about 75 tons per day of suspended solids and a population equivalent of about one million based on B.O.D., in about 40 m.g.d. The sewage strength is estimated to be increased, by these wastes, from 120 p.p.m. suspended solids to 170 p.p.m., and from 95 p.p.m. B.O.D. to 145 p.p.m. Many other industrial wastes are present in the Southwest area that are not received at the North Side plant, and of a different type than those at the Calumet Works, which are mainly from steel mills and chemical plants.

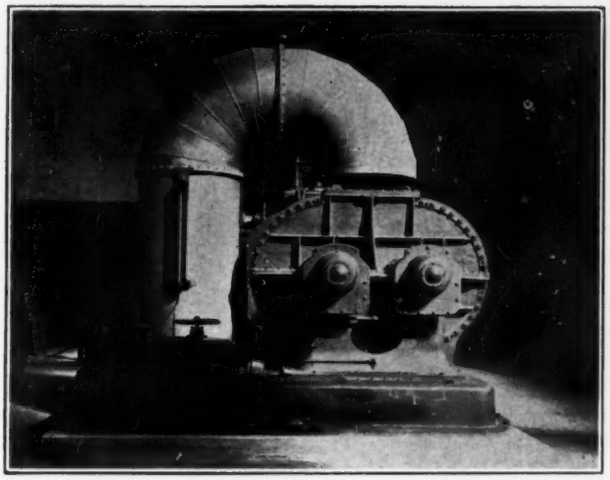
The Southwest Works is now operating at about 320 m.g.d. and producing 200 tons per day of dried fertilizer (referred to later). Results will not be representative until all sewers are connected. The air consumption, including channels, has averaged 0.56 cu. ft. per gallon from July through Dec., 1939.

The new Tallmans Island activated sludge plant, third project in the sewage treatment program of the City of New York, has been in operation during 1939. The flow has been lower than expected, averaging 15 m.g.d. or less, compared with the design estimate of 40 m.g.d. No significant data are therefore available to indicate whether the multiple sewage inlets to the aeration tanks have effected any economy in operation. This design had two interesting objectives—initial aeration of returned sludge and progressive feeding of settled sewage during the aeration period—the end sought being a flexible distribution of the rapid oxygen demand load. Apparently the same idea has been in operation at Hilversum, near Amsterdam, in the plant designed under Dr. Kessener's direction. If a control can be operated in parallel at Tallmans Island, the comparative data will be very enlightening.

The term "tapered aeration" is flung around rather sapiently when two or more activated sludge addicts get together, but convincing data have not been produced to date to show actual proven savings by using the approved taper. Parallel experiments, one tapered and one untapered, would give convincing data. As things now stand, the merits rest on some knowledge concerning oxidation rates, considerable theory, and enthusiasm for mathematics.

Laboratory research has been of great value, however, in advancing our knowledge of the nature and mechanism of action of activated sludge. The work of Bloodgood, Ruchhoft and Sawyer during 1939, and prior thereto, has supplied much new information which ought to be put to practical use. Recent British comment indicates a lively interest in the progress of this research in the United States.





America's Premiere Gas Engine Installation Is That at N. Y. City's Tallmans Island Plant Which Develops 3500 H.P.
(Here pictured are the four engines driving crude sewage pumps, and the blower end of one of the engine-blower units, of which there are four.

A comprehensive compilation of design characteristics of activated sludge plants has been made by Mr. Robert T. Regester, Consulting Engineer (*Proc.* Am. Soc. Civ. Eng.). Some data on operation are also given. This paper is a good reference work, but hardly a sufficient guide to improvements in activated sludge practice.

Trickling Filters

So-called "high-rate" filters are nowadays "high-pressure" topics of conversation.

The mind accustomed to the classic rates of 2 to 4 m.g.a.d. grows dizzy when told that equal results can be obtained at 20 to 30 m.g.a.d., but *not* in the taboo region of 7 to 10 m.g.a.d. This levity of the writer is not seemly, however, in view of the fact that the advocates of high-rate filtration have demonstrated that a greatly increased removal of B.O.D. *can* be accomplished if the filter is designed and operated properly. The proper requirements are:

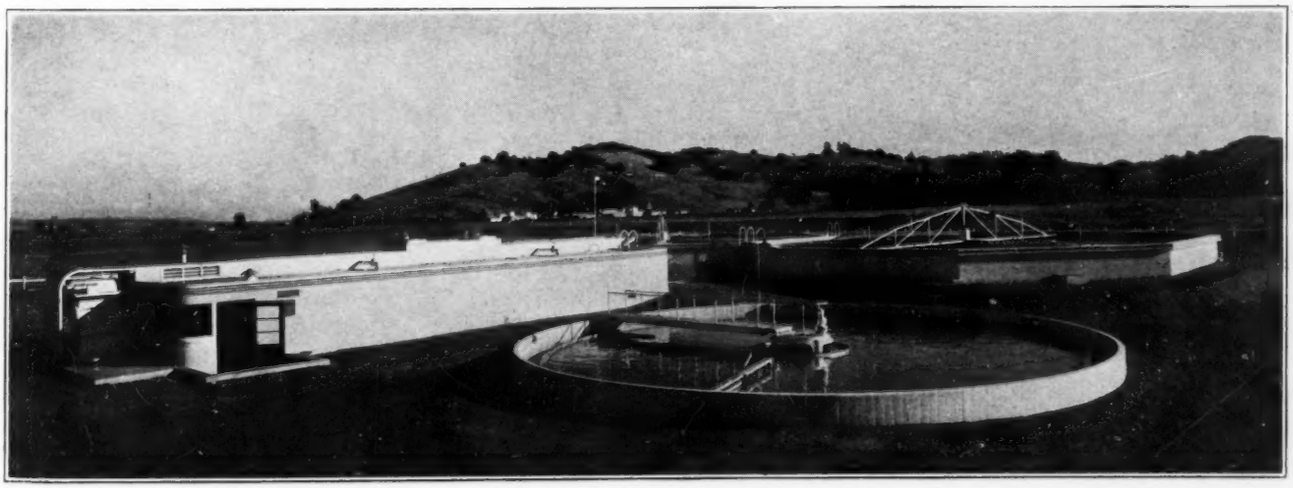
Coarse stone (first stage)
Re-circulation and dosage at a constant rate
Open underdrains
Continuous unloading

The developments in high-rate filters in 1939 were:—

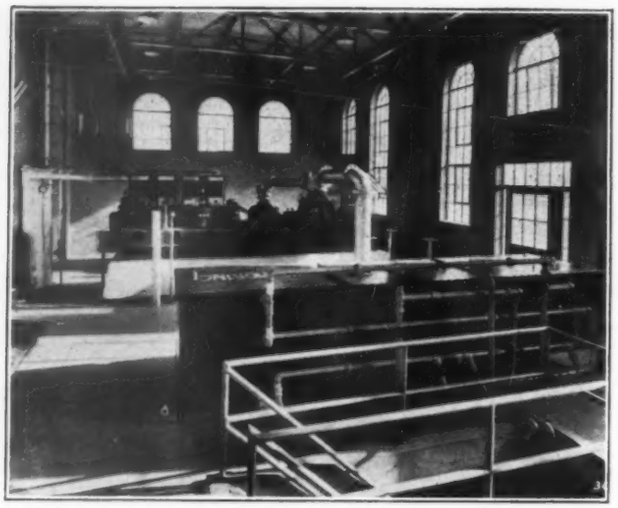
Drs. Halvorson and Piret reported results of experimental studies of air currents in a trickling filter. In summer the flow was downward, in winter upward. The rate of air flow varied in proportion to the difference in temperature between the outside air and the water. The dragging effect of the water was negligible.

Results of operation of a small high-rate filter at River Falls, Wis., were reported by Halvorson and Smith. This filter had a diameter of 25 ft. and was 8 ft. deep. The media was tubular tile. The dosing rate varied from 9 to 24 m.g. per acre per day. The sewage was very strong, containing creamery, cheese factory and laundry wastes. Rates of application were over 40,000 lb. per acre per day. The effluent, however, was high in B.O.D., varying from 58 to 152 p.p.m.; raw sewages varied from 286 to 495 p.p.m. The Halvorson filter seems to be well suited to these conditions—strong sewage and intermediate quality of effluent.

The Jenks "Biofilter" has been taken up by the Dorr Company, and Dr. A. J. Fischer has published data on tests at Petaluma, Calif. Practically all installations are in California, with one single-stage 0.8 m.g.d. unit at



The Plant and High-rate Filters of Petaluma, California
The trickling filters with rotary distributors have but 3 ft. deep stone beds, which are operated in series at very high rates. The process is known as the Jenks 2-stage Bio-filtration Process.



Gas Engine Driving Blower at One of the Smaller Plants —Chicago Heights, Ill.

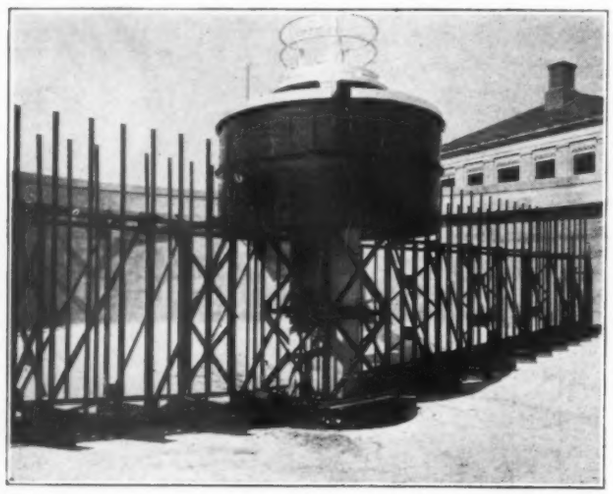
(In the foreground are the three "iron-sponge" filled scrubbers for removing the corrosive sulphide and other impurities from the gas.)

Loveland, Colo., 60 ft. in diameter. The filters are only 3 ft. deep. Re-circulation is extreme, varying usually from 2.5 to 5.0 times the rate of flow of sewage. As with the Halvorson filter, the Jenks 2-stage filter seems to be best adapted to strong sewage and has been attracting considerable attention as a process of treating industrial wastes and waste impregnated city sewage.

Both types of filters, Halvorson and Jenks, were studied for several years in experimental installations at the West Side Works of The Sanitary District of Chicago, but on this weak sewage neither filter made a very impressive showing.

Sludge Digestion and Use of Gas

A rather large heated digestion tank has been installed at Baltimore. It has a diameter of 100 ft. and depth of 25 ft. A previous experimental test over a period of seven months, in which a stirred and an unstirred tank were compared, resulted in production of 10 per cent more gas



Activated Sludge Concentrating Thickener at Baltimore, Md.

Is 80 ft. in diameter. Top—Water chlorination suppresses biological action, while the Dorr "picket-fence" mechanism stirs the water out of the sludge. The scheme was also adopted at N. Y. City's Tallmans Island Plant, and continues in use at Phoenix, Ariz.

in the stirred tank, and 5.8 ft. of scum as compared with 7.6 ft. in the unstirred tank. Stirring mechanisms were therefore specified for the large tank.

Experimental runs on a very small scale at Los Angeles also indicated a much greater rate of digestion in a stirred tank, running up to 13 lb. per cu. ft. per month, an almost unheard-of rate. However, the stirred tank appeared to give better results (more gas and greater reduction of volatile matter) at all rates of feeding. The Los Angeles tests were unfortunately on such a small scale that, as a basis for full-scale design, the results must be accepted with caution.

The Rahway Valley, N. J., plant includes two-stage digestion, with a very flexible layout of piping that permits recirculation of sludge from and to any of the four tanks. This was found very useful, and recirculation is reported to have stopped foaming within two days. Two-stage digestion is standard practice now, because of its economy and efficiency.

Power Generation

The use of gas in gas engines was extended considerably in 1939. The 3500 h.p. installation at the Tallmans Island plant is the largest in America, but is exceeded by the 6,500 h.p. installation at the West Middlesex plant near London.

Small gas-engine installations were reported at Michigan City, Ind. (74 h.p.) and Green Bay, Wis. (90 and 120 h.p.). At the latter plant Geo. C. Martin, Sup't, reports that purchased power would have cost $8,860 for the first ten months, as compared with an operating cost, including interest and depreciation, of $6,030.

At Peoria, where a large amount of gas is available from the digestion of industrial wastes, Kraus and Longley report an annual saving of $31,000 by operation of two gas engines, one a 300 h.p. unit driving a generator, and the other a 525 h.p. unit direct-connected to an air compressor. It is estimated that the first cost of $111,000 will be retired in five years.

More attention is being given to cleansing the gas, particularly in removing the destructive sulphides contained in many digester gases. Examples are Peoria, Galesburg and Chicago Heights, Ill., Battle Creek, Mich., and Rahway, N. J.

Garbage Digested With Sludge

The Lansing, Mich., plant has been of particular interest because it has received all of this city's garbage which is shredded by passing it through hammer mills and consigned directly to the digesters. Results for the fall of 1939 indicate the effect of this procedure. The supernatant liquor suffered. It contained from 1.5 to 3.3 per cent solids. Usually the weight of dry solids leaving in the supernatant was greater than the weight of dry solids introduced in the garbage. The supernatant has been returned to the primary tanks and whatever solids escape with the primary effluent have apparently been flocculated and removed in the aeration and final settling tanks. The daily additions of sludge and garbage to the digesters were approximately as follows:—

1939	Lb. per Day, Dry Weight Sludge	Garbage
August	16,600	11,500
September	12,000	12,600
October	27,500	7,900
November	23,500	9,700

Considerable difficulty was reported due to the bones,

eggshells, bottle caps, etc., which settled out in the digesters and clogged the sludge lines. The garbage solids have greatly increased the production of gas.

At Gary, it is planned to grind garbage at the sewage treatment works and discharge it into the main sewer and eliminate a good part of the haul to deliver it at the plant for direct addition to the digesters. On this account three additional digesters are being added to the original six, each with a capacity of 125,000 cubic feet. The new plant providing activated sludge treatment is at present under construction.

Sludge Concentration and Dewatering

Centrifuges

Centrifuges have been installed at Columbus and at Lansing for concentration of activated sludge prior to digestion. This does not seem to work unless the sludge is effectively screened before it is centrifuged. At Peoria Kraus and Longley investigated the centrifuge and screens experimentally and decided that although activated sludge could be concentrated to 5 per cent solids, the operating and maintenance costs were too great, and centrifuges were not installed. They stated that the centrifuge could not handle primary tank sludge or digested primary plus activated sludge because of the gritty materials present in these sludges.

Centrifuges of another type were removed from the Niagara Falls plant. An American Centrifugal machine is now being operated at Elizabeth, N. J., for concentrating sludge; another is in regular use at Jamaica, N. Y., for dewatering fine screenings. At Milwaukee basket type centrifuges have long been successfully used for the same purpose, preparatory to incineration.

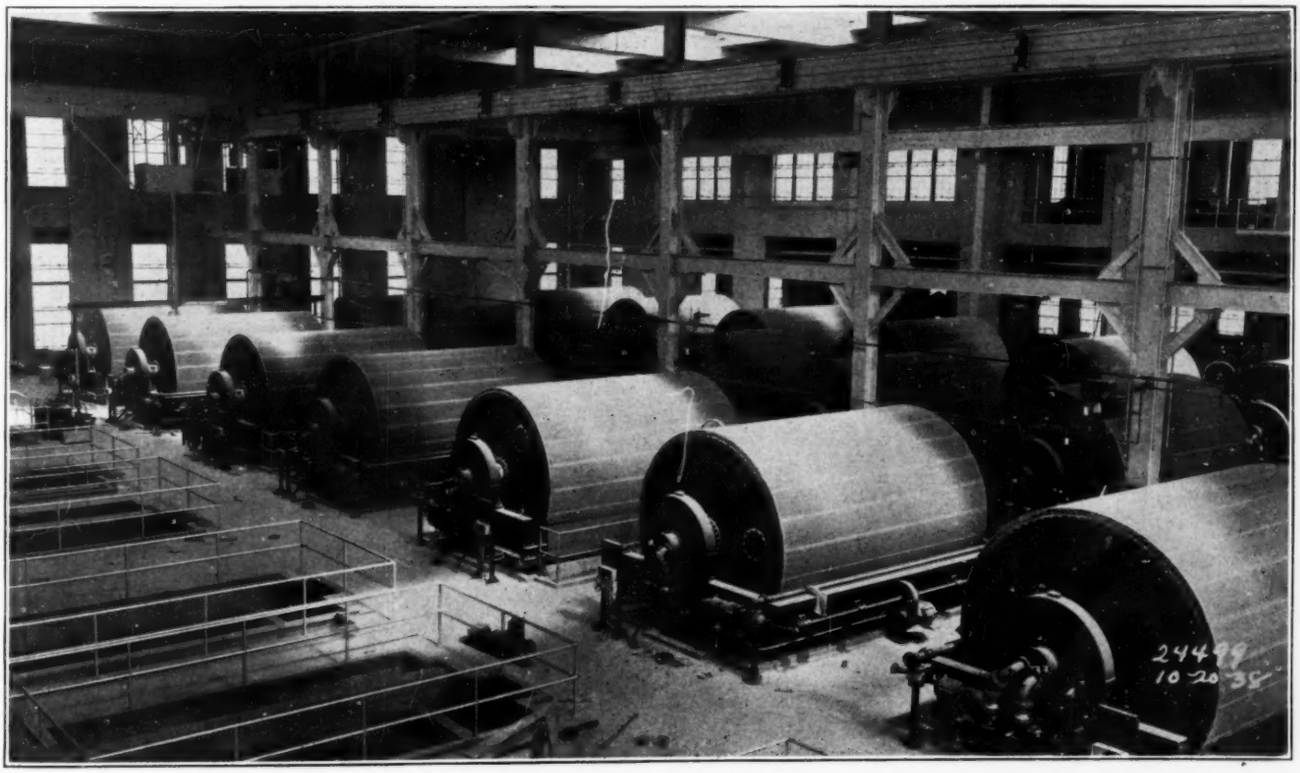
Vacuum Filters

The vacuum filter still remains supreme for dewatering sludge. The largest installation in the world (that at the Chicago Southwest Works), comprises 24 filters, each of 570 sq. ft. area. Many smaller installations were completed or in initial operation in 1939, including two 500 sq. ft. units at Baltimore, eight 500 sq. ft. units at Detroit, two 350 sq. ft. units at Hartford, Conn., and a number of large units at Buffalo and Cleveland. All these and other vacuum filters operate about the same mechanically, but the chemical requirements for flocculating sludge prior to filtration differ greatly.

Elutriation

Elutriation, a form of sludge washing, is being used more widely on digested sludge. Results at Washington, Hartford, Winnipeg and elsewhere have demonstrated that the ferric chloride requirement of elutriated digested sludge can be reduced to one-third or less of that required by unelutriated sludge. On the other hand it has been shown at Buffalo that with sludge from short period digestion the ferric chloride requirement can be reduced equally by use of lime. Elutriation is of no value on undigested activated sludge, and it is only moderately successful on undigested crude solids, even though such be allowed to get a little stale. The usual types and amounts of conditioning agents for various sludges are shown below:

Type of Sludge	Conditioning Agents (% Dry Basis)		Filter Cake Moisture
Primary Sludges	$FeCl_3$	CaO	% H_2O
(a) Undigested	3	8	68
(b) Digested	4	10	63
(c) Digested—Elutriated	1.5	0	70
Activated Sludge	6	0	81



World's Largest Installation of Sludge Filters

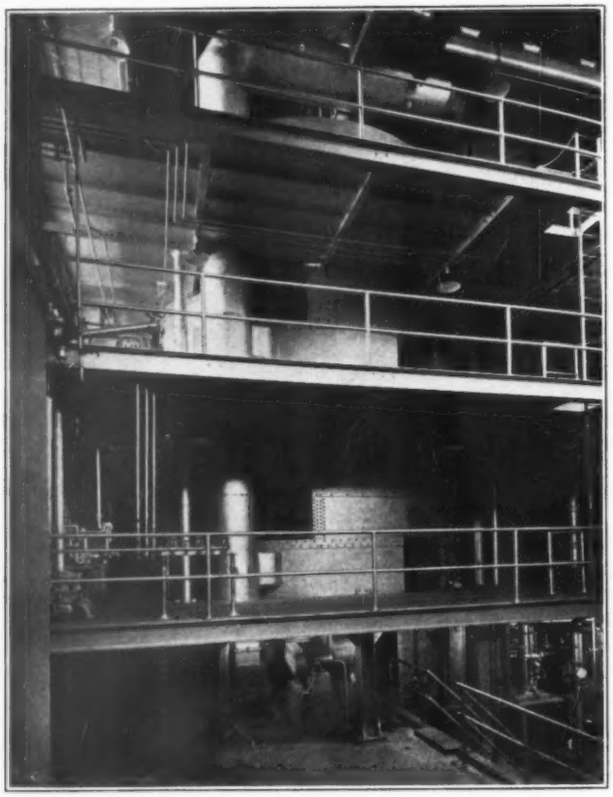
This battery of 24 vacuum filters at Chicago's Southwest Plant will dewater solids from 500 m.g.d. of sewage and those from 200 m.g.d. pumped over from the North Side Plant. The new plant is now producing 200 tons of finished fertilizer daily.

Lime and ferric chloride are used with primary sludge, raw or digested; if digested and elutriated, the lime can be eliminated and the ferric chloride reduced to one-half or one-third of the amount used for unelutriated sludge. For activated sludge, neither elutriation nor lime is effective, comparatively large amounts of $FeCl_3$ must be used, and the cake will be high in moisture.

Valuable information on sludge conditioning, elutriation and filtration is contained in a series of papers by Leroy W. Van Kleeck, published in WATER WORKS AND SEWERAGE in 1939. A. J. Beck described an automatic pH recorder used at the Calumet activated sludge plant of The Sanitary District of Chicago.

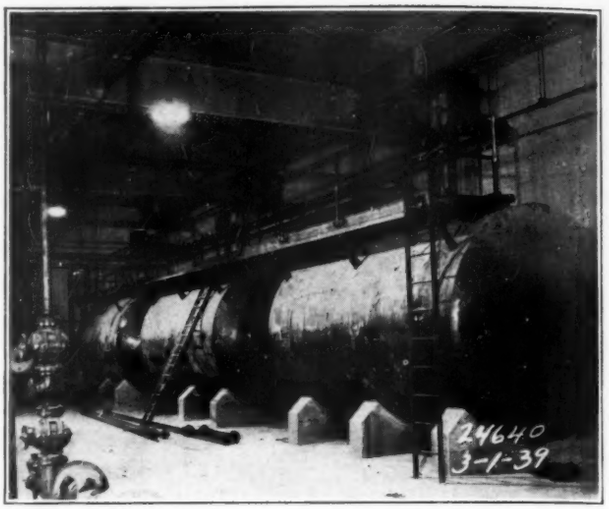
Sludge Drying and Incineration

The year 1939 was notable for the progress made in drying and incineration of sludge. Buffalo, Chicago and Minneapolis operated the two types of apparatus developed for this purpose—multi-hearth incinerators and flash dryers. A symposium on results obtained at these three cities was held at the meeting of the Central States Sewage Works Association in Chicago in October, and published in the November, 1939, *Sewage Works Journal*. [Also see digests of these papers in WATER WORKS & SEWERAGE for December, 1939—page 493 et al.] The flash dryers at Chicago have been used almost exclusively to produce dried sludge, which has been sold as a fertilizer. Very little sludge has been burned, because of the far more attractive alternative of fertilizer production. Digested sludge at Buffalo and fresh sludge at Minneapolis have been burned. The requirement for fuel at Minneapolis was less than had been anticipated in design —on the 90-day acceptance test the cost of fuel oil was $1,695 as compared with a guarantee of $3,293, and the total cost of incineration was $4,560 as compared with a guarantee of $7,084.



One of the Three 8-Hearth Nichols Incinerators at the Minneapolis-St. Paul Plant

These units of 90 ton capacity each have considerably exceeded guarantees as to capacity, performance and operating costs.—See text.



Three Units of the Battery of Rubber Lined Ferric Chloride Storage Tanks—Chicago Southwest Plant

At Milwaukee, screenings have been successfully burned in a multiple-hearth type (6-hearth, 40-ton cap.) incinerator. The screenings are centrifuged to 70 per cent moisture, mixed with grit, and fed to the incinerator. The new incinerator has given far better performance and better cost record than the old hand-stoked units formerly used.

Fertilizer Production

Apparently people will buy properly prepared dried digested sludge from plain settled solids and pay a good price for it, provided a sales drive is put on, as shown by results at Toledo, reported in 1939. The total production of digested sludge, on a dry basis, is about 5,000 tons per year at Toledo. Since 1936 some of the sludge has been taken from the glass-covered sludge beds, shredded and sold. The capacity for such preparation and handling is estimated to be 1,250 tons per year. The total sales, practically all local, were as follows; 1936—500 tons; 1937—958 tons; 1938—600 tons. A net profit of $2,785, $4,797 and $3,875 was claimed for the three years. The sludge was sold at from $8 to $10 per ton. No analyses are reported. Grand Rapids and Dayton has also been selling prepared air dried digested sludge, for same years. The proportion sold to total production is usually low, but one year at least Dayton was "importing" sludge in order to fill the demand.

Dried fresh activated sludge, according to a report made some years ago by Dr. E. E. DeTurk, agronomy expert at the University of Illinois, contains twice as much nitrogen as digested crude sludge, and the nitrogen is twice as available. Therefore, there is no doubt concerning the value of activated sludge when evaluated on the fertilizer basis of per cent of nitrogen and P_2O_5, and it finds a ready sale. Milwaukee sells about 130 tons per day. Chicago has been producing up to 200 tons per day at the Southwest Works, and is selling all of it without difficulty. In consequence but little sludge has been burned with powdered coal, such being contemplated as an alternate.

The distinction between dried digested sludge and dried fresh activated sludge should be kept clearly in mind, and one wonders whether efforts to promote the sale of the former are worth while. [If the actual profit in dollars

is what the author refers to, he is likely right. However, there is a beneficial psychological value to consider in the fact that the plant manager can show "Income from By-products" on his records. Such records please the average City Father even though the net profit is but "pin money."—Ed.]

Safety and Plant Maintenance

Various papers were presented in 1939 concerning safety measures at sewage works. Gas hazards are most frequently discussed. With reasonable precautions, protection against the toxic, asphyxiating, or inflammable gases can now be assured. The use of canaries as carbon monoxide or oxygen deficiency detectors at Freeport, L. I., is unique. In addition the plant is equipped with an oxygen deficiency detector and automatic alarm system.

The explosion in the Imhoff tank pipe gallery at Dayton, Ohio, made the headlines early in the year. Operating galleries are dangerous locales in any digestion plant.

A series of valuable articles on plant maintenance was presented by L. M. Johnson, in which the operating and maintenance procedures of The Sanitary District of Chicago are detailed.

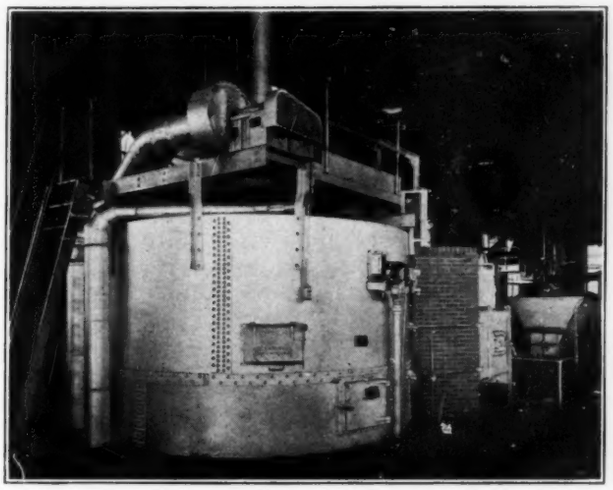
Meetings and Operators' Conferences

The American way of spreading the news of progress in sewage treatment is to organize groups of chemists, engineers, professors, equipment men, and reporters in various sections of the country, to arrange annual or more frequent meetings, and to listen to a program of papers detailing the news of the year. The chemists and engineers tell what they have done, the professors add their contributions and criticisms, the equipment men note what equipment seems to be needed and make plans to produce that equipment, and the reporters take it all down and publish useful resumés of the papers and discussions. Undoubtedly the most practical discussions take place in the halls or exhibition rooms, and the most imaginative ones in the cafes and tap-rooms. [And, some of the latter would make entertaining reading if they got into print.—Ed.]

After the meeting is over, everyone goes back to work with lots of new ideas, and with helpful suggestions as to how to solve troublesome problems.

The Federation of Sewage Works Associations has bound together these local groups into a national (in fact, international) Federation that has grown to include nearly 3,000 members, as compared with a few hundred in 1928, when it was organized. Along with the growth in membership there has been a comparable growth in prestige and influence. The year 1939 has been important in the Federation's history, as a movement was initiated looking toward increased activity, centralization of effort and direction and a greater service by the Federation as an organization more closely knit for such service to the sewage workers' fraternity.

The Anniversary Volume, to celebrate the tenth anniversary of the founding of the Federation, appeared early in 1939. "Modern Sewage Disposal," edited by Langdon Pearse, and containing chapters by well known and qualified contributors active in the sewage disposal field, has rounded off the most significant decade in the history of sewage disposal in America. The volume stands as an authoritative record of the status of sewage treatment, of waste disposal and stream pollution, not alone in America but also in the other important centers of sewage disposal progress abroad.



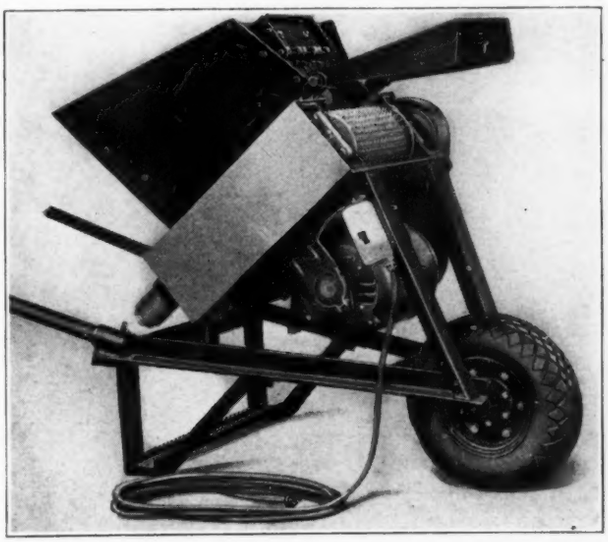
Milwaukee's "Multi-Zone" 6-Hearth Furnace for Destruction of Screenings and Burning of Grit

(This view of the 40 ton unit is of the top or drying zone only.)

The World's Fairs—1939

The fairs at New York and San Francisco drew the nation's attention to the progress of sanitation, and particularly at New York the nearby Tallmans Island Treatment Plant attracted many visitors. The other plants, Wards Island and Coney Island, added emphasis to the fact that New York City has embarked on a tremendous program of sewage treatment to alleviate the polluted conditions of its surrounding waters.

The impression at San Francisco may not have been so good, due to the slowness with which the East Bay cities have moved toward sewage treatment, but San Francisco has made a good start, with the Golden Gate and Richmond-Sunset plants in operation, and recently a commission of engineers has been selected by the East



Royer Jr. Sludge Conditioner

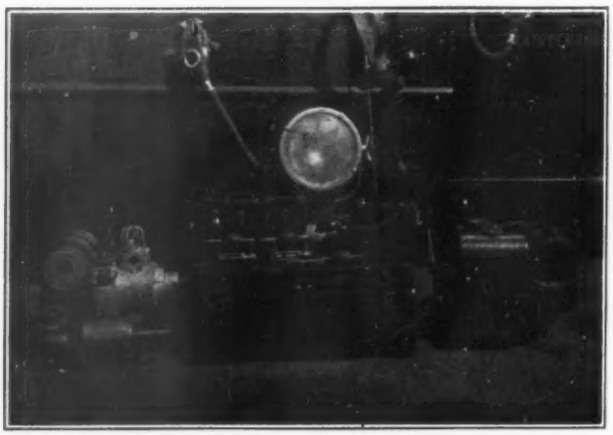
This smaller sized shredder was introduced in 1939 for the smaller sized plants.

The New and Compact Davis Inhalator
Made available in 1939 for treating cases of asphyxiation or gas poisoning.

Bay cities to report on a comprehensive scheme of sewage treatment.

Overall Treatment

In point of treatment, Chicago is now far ahead of any other major city in America, with about 70 per cent overall removal of B.O.D. from a population of 4,400,000, equivalent to 3,000,000 effective population treated. New York accomplishes less than 25 per cent overall reduction of B.O.D. for its population of 8,100,000. Below these two largest cities, several such as Milwaukee, Cleveland, Baltimore and Columbus are operating plants which accomplish 85 to 90 per cent purification, but the effective treatment for the total population averages somewhat less than this, and the overall population effect is considerably lower than that at Chicago or New York. St. Louis is at the bottom of the list, as no sewage is treated and garbage is ground and discharged into the river, thus giving the city the unenviable distinction of having *less than no treatment.*



A Full Complement of Safety Equipment for Plant and Sewer Maintenance Work. The Joint Meeting—A Sewerage Commission serving Newark, N. J., and 10 other municipalities.

The War

The War has paralyzed progress in sewage treatment in Europe. Technical journals are bare of information, although still carrying on. A large amount of gas produced at the West Middlesex plant near London is being used for motor fuel. Under the present regime in Germany (even before the war), all types of modern sewage treatment were officially banned in favor of land utilization. Thus, at Hamburg, well-prepared plans for treatment of sewage, based on operation of a testing station for several years, were scrapped by bureaucratic orders to install land treatment. Other German cities have encountered similar orders.

Paris was well along toward operation of its new 50 m.g.d. activated sludge plant, but it is probably not in operation. The Netherlands, under Dr. Kessener's aegis, is undoubtedly the most advanced nation in sewage treatment progress in Europe.

We in America may be thankful that we have been free and during the last decade able to complete the world's largest program of sewage treatment.

What of the Future?

Many more sewerage and sewage treatment projects are ready to go forward, but are temporarily on the table while the majority of city officials are hopefully expecting the Federal government to renew its financial aid, in one form or another, to those who wish to provide better water supply and sewage disposal facilities.

Through one agency, the Works Progress Administration, now a unit of the Federal Works Agency, assistance is still available for putting through the smaller water or sewerage projects under a scheme that resembles the former method of procedure under the Public Works Administration. During 1939 several new projects have been completed most satisfactorily to city, contractor, consulting engineer and F.W.A. under this new "W.P.A. —Contract Plan," which involves contractor bidding and handling of the project in the normal manner of regular contract procedure.

Those authorities with larger projects who are expectantly awaiting a renewal of Federal grants in aid may be doomed to disappointment, for the general feeling amongst those who should know is that no public works aid beyond W.P.A. assistance is to be proposed to the present Congress. In the meantime, with wars in progress and prices not likely to go lower (either on labor or materials) those who delay, while hopefully awaiting Federal assistance, may come out considerably the losers, by letting the present cheap money market slip away and may find inflated prices adding materially to the cost of projects now ready for construction.

(To Be Continued)

[Part 2 of Dr. Mohlman's review will follow in the next issue. It recounts developments and trends in correcting industrial pollution by recovery of products, leakage stopping, the treatment of non-recoverable wastes by industry alone, or in some form of combination sewage and waste treatment plants operated by the municipality.]

Wow! Some Fish Story

Here is a press release from Denver to national newspapers. It is intriguing!

Trout for Chlorine Test

Denver, Oct. 26 (A. P.)—George J. Turre, Denver Water Department chemist, discovered mountain trout are susceptible to chlorine. He suggested trout pools be established at five Denver filter plants to indicate when too much of the germ-destroying gas has been used. George F. Hughes, department manager, approved the idea.

TRANSPORTATION

In Which Three From Six Equals Speed Plus Economy

By D. R. TAYLOR
Plant Superintendent
ROANOKE, VIRGINIA

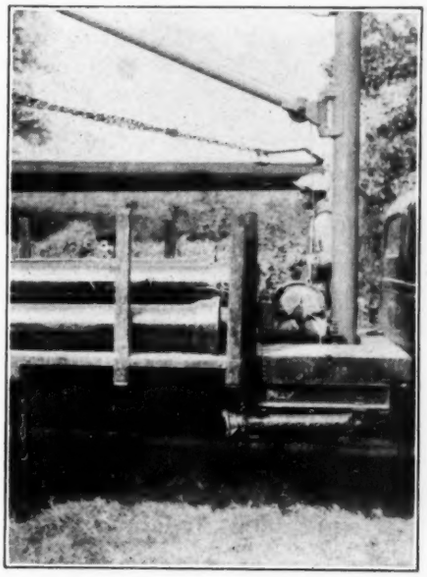
Dear Bill:

Your long newsy letter was very much appreciated. I am sure that you are pleased with the completion of your West End project. With the extensions and tie-ins that you have made in this section you no doubt have a well-designed and an adequate distribution system in this section of your city that should bring you commendation from your customers as a result of lower fire insurance premiums as well as a higher rating by the Fire Underwriters when your system is inspected and graded again.

Your problem of transportation is one that many of us were confronted with when we began using cast iron pipe 18 feet long. If you have much hauling to do, it will pay you to buy a long wheel-base truck chassis and to have a power crane installed on it and have a platform body built locally to meet your particular needs. I am enclosing two photographs of such a truck chassis that we purchased and equipped when we began the use of 18 foot pipe. The larger picture shows three men loading 8-inch pipe.

The crane was obtained from the Baker Equipment Corp., Richmond, Va., who are our nearest agents for the Gar Wood Industries of Detroit. Your truck chassis should have a wheel base of at least 220 inches. The dimensions of our particular piece of equipment are as follows: The length from the back of the cab to the end of the frame is 19 feet. The crane utilizes 3 feet of this space, and our platform body is 17 feet long, allowing the body to project 1 foot beyond the end of the frame. This allows 18 foot pipe to project 1 foot beyond the body with a total overhang of 2 feet beyond the end of the frame. This is permissible and within the bounds of good practice, as recommended by truck manufacturers. For flexibility and economic transportation, I would suggest that you purchase a heavy duty two-ton chassis, with which you can easily haul a load of four tons from your pipe lot to the job in question without abusing the equipment.

In the smaller picture you will observe the power crane in service. The chain sling with a hook on each end, one of which may be seen in the spigot end of the pipe, was improvised by one of our foremen. The jack, shown in the foreground folded up underneath the crane platform, is furnished with the crane. The jack on the side from which you are raising or lowering the load is unhooked and allowed to swing down to the ground to support the platform while you are loading or unloading.



A close-up view showing power crane, sling and operator.

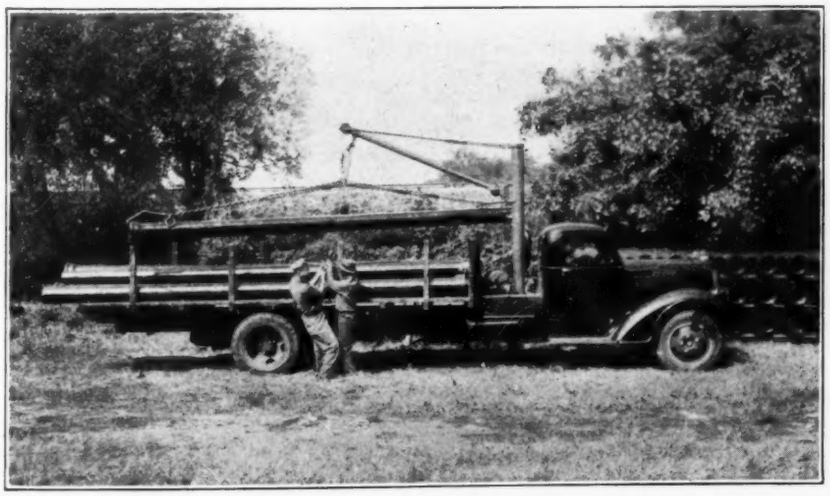
This crane can be obtained with various capacities and booms of several lengths. I would suggest that you purchase one of 3000 pounds capacity with a 10 foot boom. It may be of interest also to you to learn that the mast and boom is demountable and can be easily removed when not needed.

In the good old days, it required six men to unload a car of eight inch pipe, but, with the outfit described above, three men can do the same job and do it quicker.

If you are interested in such a purchase and wish any more information, drop me a line, or, better still, bundle up the family in the old "puddle jumper" and come on down and get a load of ours.

Sincerely yours,

Tom



With This Rig It's a Cinch—To load 18-ft. lengths of 8-in. cast iron pipe.

EXPERIENCES WITH THE NEW RUBBER JOINT PACKING*

Developed to Replace Bacteria Harboring Jute and Hemp; Proves Worthy in Trial on Akron System

By W. R. LA DUE
Sup't. & Engineer, Bureau of Water Supply
AKRON, OHIO

SINCE the advent, some 300 years ago, of the use of cast iron pipe for conveying water for domestic consumption, various materials have been used in making joints.

The mechanics of making up a joint in water lines constructed with bell and spigot end pipes requires the insertion of some material into the bell to form a "stop," which centers the spigot end of the pipe and prevents molten jointing material from running into the pipe through the space between the bell and the inserted spigot end of the two pipes. This material is generally referred to as "packing" and various substances have been employed such as clay, asbestos, paper, jute and hemp. Of late years the last two, in the loose or braided form, have been almost universally used.

Until less than 10 years ago, new water mains reasonably free from visible dirt, were laid after careful wiping of the interior with a swab of doubtful cleanliness. A pressure test was then given to indicate freedom from leakage; the line was flushed, and, since extreme care had been exercised at the treatment plant to insure sterile water, it was universally assumed that water of a satisfactory quality reached the ultimate consumer. Then, almost simultaneously over the United States, for various reasons, water works engineers began to doubt if mains thus laid were really sanitarily sufficient. The presence of foreign bodies in the lines after laying disclosed by the simple act of flushing, excited justified suspicion. More physical care was exercised to obviate the finding of two-by-fours, swabbing cloths, bricks, and similar detrimental objects in the lines. Pipes, having laid for considerable periods of time in roadside

The Author

ditches prior to laying, were judged unsanitary—regardless of the best swabbing and hand cleaning. Test samples — taken from newly-laid mains—were found to contain "coliform"* organisms of objectionable and sometimes dangerous counts. Then the finger of suspicion was pointed at the joint packing employed and investigation proved it a source of bacterial contamination, or else a harboring place for bacteria.

At Akron, the natural outgrowth of the desire to produce satisfactory water quality, resulted in the introduction of means to sterilize the new lines when laid. Sound methods were employed, using chlorine as a gas or in its numerous commercial hypochlorite compounds. The former was usually applied to the water used in flushing, and the latter was introduced in small quantities in each pipe as laid, where it was dissolved by slow filling, becoming effective by retention, and later removed by the flushing process.

Akron's Experience With Jute Packing

These methods of main treatment usually produced good samples from a new line *only immediately after* flushing. Subsequent tests revealed the presence of increased counts of coliform organisms in the samples. In one particular case of several thousand feet of 16′ pipe laid in Akron in 1932 the bacterial counts were so high that the line was not placed in service until after several months had elapsed covering experimentation, removal and repouring of joints and extensive sterilization.** From subsequent experience, undoubtedly the bacteria present would have proven harmless to consumers, but there was potential danger in the fact that they could not be distinguished with certainty from harmful bacteria. The jute was naturally suspected. Upon test it was found capable of producing and sustaining subsequent bacterial growth in a seemingly sterilized main.

Efforts and experiments to sterilize hemp and jute (the latter being the worse offender) have been carried out in numerous cities with varying degrees of success. Mercuric chloride, copper sulfate, sodium carbonate, cupric ammonia, calcium hypochloride and their varied commercial compounds and derivatives have been used in sterilization tests; the mercuric chloride probably being the most effective.

One thing appears certain, namely, that so far as permanent sterilization of mains laid with jute or hemp is concerned, the use of chlorine is but partially successful. Even though the hemp be thoroughly penetrated and saturated with the chlorine, the bacteria will eventually thrive long after the chlorine has been dissipated. It is encouraging, however, to state that new mains now being laid are far superior, bacterially, to those laid ten years ago.

*This paper was read before the Ohio Conference on Water Purification and is reproduced by permission.—Ed.

*The coliform group "includes (1) aerobic or facultative anaerobic (2) gram-negative (3) non-spore forming organisms which (4) ferment lactose with (5) gas formation. This is the coli-aerogenes group of the eighth edition of Standard Methods. It includes the genera now called Escherichia as well as those called Aerobacter. It also includes the Citrobacter family. It is not specific for Esch. colinor is it specific for Aer. aerogenes."—(Journal A.W.W.A., Sept. 1939, p. 1511)

**"Contamination of water in a New Pipe Line by Jute and Hemp Packing," by J. S. Gettrust—Report of 12th Annual Ohio Conference on Water Purification, October, 1932.

A New and Sanitary Packing Appears

Improvement is something always to be desired, and such seems to be the new rubber packing material developed by Mr. Hayes R. Kuhns of Killbuck, Ohio. Mr. Kohn's invention seemingly confirms his own slogan—"When better joints are made, Kuhns will make them." This simple rubber joint packing appears to have proven the slogan—and, at a cost no greater than that for ordinary braided hemp.

The new rubber packing comes in two forms: one a thick-walled tubing—the other is in the form of solid wedge-shaped strips. Both are available in coils, similar to the familiar coils of braided hemp from which various lengths are cut to form a single ring with overlapping ends required for insertion into bell and spigot joint.

Inventor Kuhns and His "Rubber Yarned" Joints

Akron's Experience With It

Mr. Kuhns first presented his material in Akron, Ohio, in the fall of 1938 when the Akron City Water Works installed approximately 200 feet of experimental 6″ main. This line was tested the day it was completed and indicated a leakage of only 60 gallons per inch mile per day (60% of the allowable) and produced water samples testing only 10 bacteria per c.c. We have subsequently laid lines totaling about 1,000 ft. with leakage tests varying from a minimum of 60% to a maximum of 80% of the allowable leakage of 100 gallons per day per inch-mile, and producing bacterial samples ranging from a minimum of four to a maximum of fifteen organisms per c.c. Other cities, the largest being Indianapolis possibly, have used the rubber packing on a test basis with equally satisfactory results.

Pipe layers like the new packing for several reasons; it is easy to handle and place; centering is almost automatic; the yarning effort is reduced, and the loss of jointing material past the ring is practically an impossibility. In this latter feature—the hollow tubing has the advantage of better accommodating itself to surface irregularities in the pipe and to compression required in laying the pipe in curves, either vertical or horizontal. The low temperatures ordinarily encountered in jointing materials do not seem to injure the rubber.

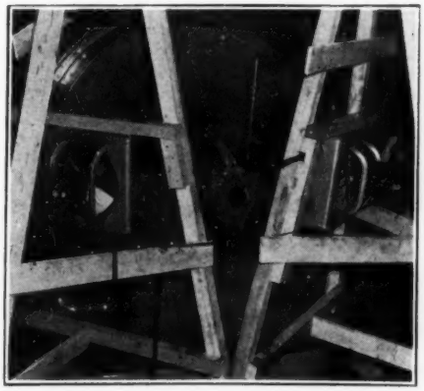
Rubber gaskets have been used in joints for years but ordinarily it has been felt that the presence of air has caused their deterioration, rather than continued exposure to water. Limited exposure to water also obviates the possibility of taste troubles. Rubber appears to offer no food supply for bacterial growth, as is evidenced by the fact that tests over a period of time do not indicate any increase in total bacteria. In general, it appears that early leakage tests of lines laid with rubber joints, show much lower leakage than those secured from other packings—and produce at an early stage fairly reliable indication of final results which usually requires time necessary for the "healing" which reduces seepage past compound joints.

Recently, standard practice has made it readily possible to treat water mains in laying so that they will produce satisfactory water on initial tests. To keep it thus has been the problem. The present method of using hypochlorite powder in the pipes and the new rubber packing in the joints, has proven the practice satisfactory bacterially through subsequent tests. Our experience at Akron, it is believed, bears this evidence. It is hoped others will experiment to the good of all.

A RAPID AND SUCCESSFUL METHOD OF DRYING FLOODED MOTORS

When a valve in a 60″ main burst at the Col. Francis G. Ward Pumping Station in Buffalo, N. Y., a major catastrophe threatened. Part of the city was without water until the old Massachusetts Avenue Pumping Station could be put into operation. Pumps, motors and the major part of all the other electrical equipment in the Ward Station was from six to ten feet under water.

By heroic measures on the part of the City Water and Fire Departments, the pump room was pumped out by the following day. The next problem was that of drying out the coils of the huge motors, without removing these units.



Emergency Installation of Fan Type Heaters Drying Motor Windings at Buffalo, N. Y.

Buffalo Forge Company was called on for eleven Buffalo Heaters, equipped with fans and supplied with steam, to be installed as rapidly as possible for drying out the pump motors. The units were placed in position on temporary rigs, blowing hot air directly into the windings of the motors. Canvas hoods placed over these small heaters and motor confined the heat.

This method proved very satisfactory, and may suggest to our readers a desirable expedient in similar situations.

AMERICA'S MOST UNIQUE CITY HALL

Goes Into Service at Lake, Wisconsin

By MYRON CALL
Milwaukee, Wisconsin

AS THE traveler enters the environs of Milwaukee on its southern border his eye is attracted by the sight of an imposing skyward reaching structure that appears oddly out of place in the setting of pastoral calm and quiet common to this suburban residential area.

On closer scrutiny the traveler perceives that this elegant concrete structure, which serves as the City Hall of Lake, Wis., is surmounted by a large silvery-domed water tank, its 162-ft. pinnacle ornamented by a flashing red aeronautical beacon.

The steel skeleton of this lofty water tower is enclosed in octagonal walls of ornamental monolithic concrete. The enclosed area comprises four upper floors, a sub-floor and two quadrangles on the ground level. This will house all the municipal offices, the council chamber, police court, jail, municipal garage; also the town's pumping and water softening equipment and the repair shop of the Water Department.

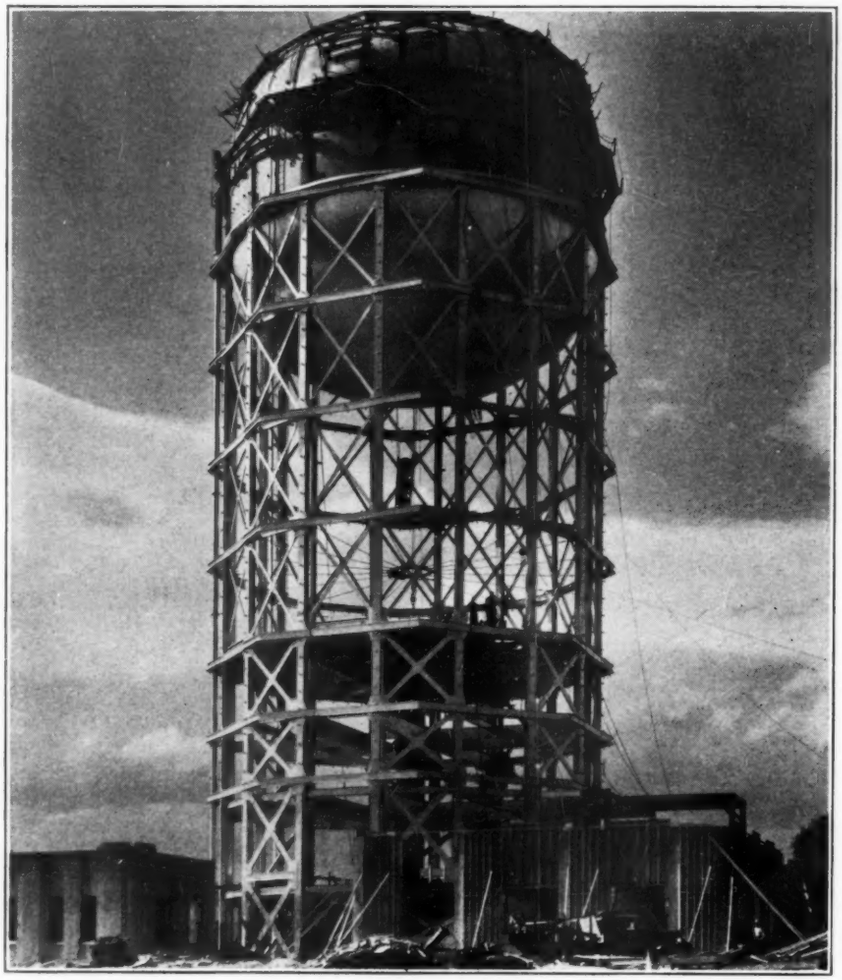
In the design and construction of this unique and highly utilitarian structure William D. Darby, Consulting Engineer, has achieved remarkable success in combining the functions of a city hall and the elevated standpipe of the Town of Lake.

Lake Michigan forms the eastern boundary of this suburb, which fact suggested the water supply be obtained from that source. To achieve this, however, an intake tunnel fully two miles in length would have been required to assure freedom from pollution and the hazards of winter clogging by drifting ice fields. A preliminary survey disclosed the fact that the expense involved would exceed twenty times that of an artesian well development. Since this artesian water is comparatively hard it requires softening, yet the expense is fully offset by the cost of the filtration plant required were lake water used.

The Town of Lake comprises an area of 3¾ square miles and boasts a population of 5,000. A figure based on a ten-year growth was decided on to establish the capacity of the feeder system, the well and storage tank.

Because of wide variations in level many communities are forced to construct a two pressure system. Such, however, is not the case here since the range varies only from a low of 43 feet above lake datum to a maximum of 150 feet for the high.

The present distribution system comprises 43 miles of centrifugally cast bell and spigot pipe and 517 hydrants. These hydrants are all equipped with shut off valves and in addition other valves are so distributed that any section may be isolated without interference to adjoin-



Some Said It Was Lake's New Water Tank; Others Said It Was Lake's New City Hall—And, Both Were Right

ing sections. A total of 909 valves are installed.

Tower Lighting Effective

The presence of Wisconsin's largest airport within the boundaries of the municipality necessitated that thought be given the selection of a site for the 162-ft. standpipe which would render the least hazard to air traffic.

In compliance with the regulations of the United States Department of Commerce the fourth floor windows below the tank are illuminated with eight 150-watt flood lights mounted on ceiling suspended brackets; and sixteen 500-watt flood lamps are hung from the tank with beams directed outward through the windows.

The pinnacle of the 1,000,000-gallon tank, fabricated and erected by Pittsburgh Des Moines Steel Co., is surmounted by two 500-watt lamps installed in a 300 M M flashing red hazard beacon with double Fresnel type lens, equipped and wired through a motor operated flasher producing forty flashes per minute.

On the roof of the third floor level eight 1,000-watt flood lamps with diffusing lenses are installed to illuminate the upper exterior walls of the tank.

Foundations

The main central tower and elevated tank rest on a foundation built up of more than two miles of tubular steel, cast in place, concrete piles driven to an average depth of 50 feet through the underlying 30-ft. strata of wet sand and into the stable clay. A feature of the foundation is that the octagonal wall around the tower as well as the wall extending out the front of the building, are supported on separate concrete slabs and piles.

The foundations for the main tower do not project beyond the outside of the octagonal wall where the four building wings are adjacent to the outside of the wall and the foundations of the wings do not extend inside of that line. A vertical construction joint is provided to separate the main tower from the building wings. This joint is also carried up into the building proper by the insertion of brass strips at all points of contact, as a precaution to permit possible unequal settling without damaging effect to the building.

A one-inch round reinforcing rod is imbedded in each concrete and steel pile. These rods have an eye formed in their upper end through which is passed a three-foot section of rod, this pierces both the eye and the walls of the steel shell three inches below the top. All piles were tested by applying 80 tons to the 25-foot piles and 100 tons to the 50-foot piles. Concrete composed of a 1-2-4 mix filled these piles.

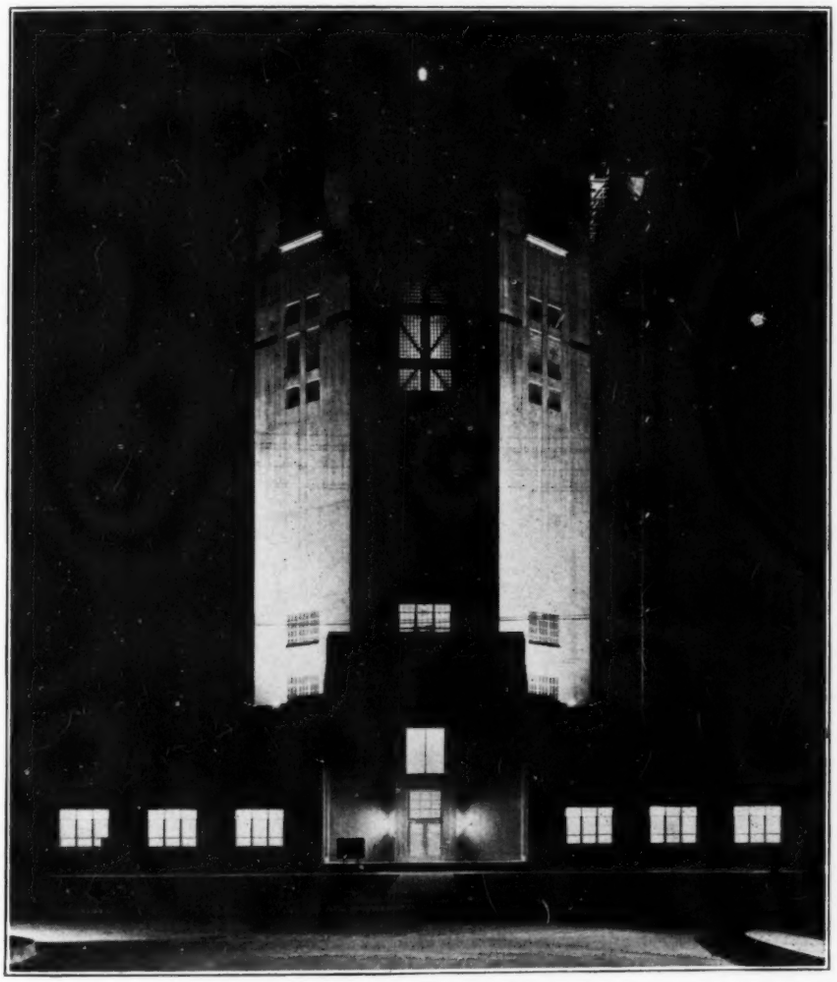
Well Development

The artesian well was driven to a depth of 1,834 feet into the Mt. Simon sandstone formation. Features of this well are a 16-inch diameter casing set inside of a 21 inch diameter for the initial 504 feet which penetrated the Niagara formation, proceeding from there a 12½-inch casing continued through the Rechinond hole to the Galena-Platteville dolomite formation for an additional 200 feet from that point a 12½-inch diameter bore extends uncased through the St. Peter's and Eau Claire sandstone and eventually into the water bearing Mt. Simon sandstone. A feature also worthy of mention is that the upper 177 feet of 16-inch casing is enclosed in a 22½-inch O. D. pipe. This space between the 16-inch and the 21-inch diameter hole to the 504-foot level was filled with cement grout, and required approximately 1,000 bags of cement.

This well's preliminary test produced a yield of 1,200 gallons per minute with a draw down of 150 feet. The water temperature is 55° Fahrenheit and a hardness test shows 26 grains per gallon and a trace of iron. To overcome this condition three gravity type Zeolite softening units are installed. Each of these units is 12x12 ft. in bed area and is capable of treating 600 gallons per minute through the 324 cubic inches of Zeolite compound—1800 g.p.m. for the three units.

These beds may be operated simultaneously or separately through manipulation of the three Permutit control panels and in conjunction with the Simplex Float Valves and Trident-Crest Meters.

All water entering these beds is first aerated by passing over a "Cascade" type of aerator composed of



And Here Is the End Result

(1) At the 162 ft. level—IMG Water Storage. (2) Intermediate and ground level—Lake's City Hall. (3) Sub-level—Lake's deep well, softening plant and pump-station, shops

5 steps of ceramic tile supporting cast aluminum trays. To further the process of aeration a 3,200 cubic foot capacity motor blower discharges over this pyramid of cascades and out to the atmosphere. Discharge from the aerator to the settling tank is accomplished through an automatic controller designed to maintain a water level within 1½ inches of the flow line of the tank.

A concrete brine tank with a capacity of one carload of salt for the regeneration of the Zeolite beds is located 300 feet from the tower adjacent to a railroad spur track. Brine is delivered to the softening plant by two 10 g.p.m. electrically-driven centrifugal pumps designed to operate automatically against a static head of 50 ft. with a brine solution weighing 75 lbs. per cu. ft.

Pumping Arrangements

The Layne-Bowler deep well pump is a turbine vertical centrifugal unit, is oil lubricated and powered by 1,200-h.p. squirrel cage vertical type motor and delivers 900 g.p.m. against a total head of 275 ft. Of this figure 250 ft. represents the lift in the well and 25 ft. discharge up through the aerator.

The Allis-Chalmers high-service pump is a single stage, horizontal split case centrifugal unit which delivers 900 g.p.m. against a head of 175 ft. and is powered by a 60-h.p. Allis-Chalmers squirrel cage motor.

Both deep well and booster pump motors are specially wound to operate on 3,810 volts a. c. 60 cycles. This comparatively high voltage was adopted to eliminate the expense of installing the conventional step down transformer bank and the attending core loss charges.

The windings of both motors are so planned, however, that connections may be readily changed to operate on a lower voltage if circumstances require the latter.

The heating of this structure is accomplished by the installation of a Type G 1783 welded steel Kewanee boiler fired by a Ray Oil Burner using No. 5 oil as fuel, from a 5,000-gallon underground tank. Numerous Trane Units and direct radiators located about the building discharge their condensate through a 15,000 sq. ft. capacity Chicago Vacuum pump operating against a 20-ft. head to the boiler.

Hot water is supplied by an Excelsior Water Heater, which is also oil fired and automatically controlled.

A welded steel chimney 24 inches in diameter and distorted in shape extends upward from the basement in one of the recesses formed by the octagonal corners. Its top terminates 5 feet above the plate steel roof and parapet wall. At all points of contact with the structural steel, supporting brackets (electrically welded) serve as mediums of alignment and support.

The 20-in. steel riser pipe drops vertically from the tank bottom for a way and then travels horizontally and downward in one of the octagonal corners of the tower. It also is fastened to girders by electrically welded brackets along its length and terminates in the pump room.

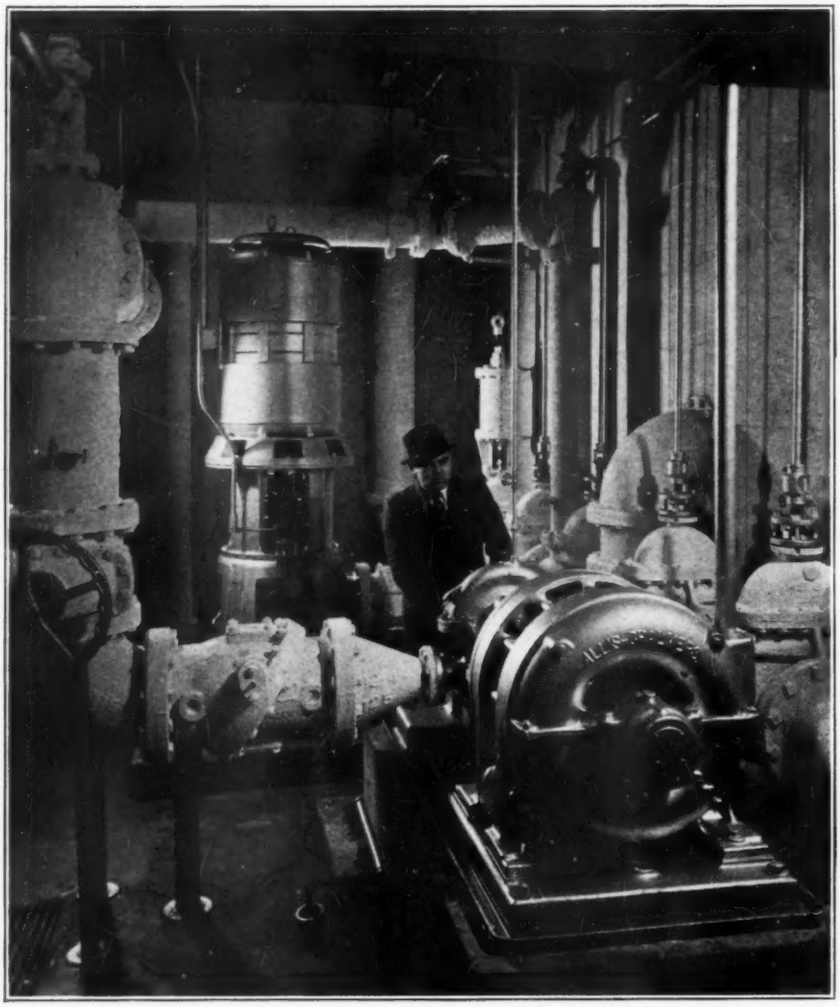
Still another octagonal corner is occupied by a 12-inch welded steel overflow pipe, which extends from the capacity line of the tank down to a storm sewer.

The building proper which terminates under the steel tank at the 4th floor is roofed with welded steel plates of 3/16 inch material supported on structural steel "I" beams radiating out from an 8-foot circle which serves as a passage for materials. The walls of the tower are hung on the steel work in a manner employed in sky-scraper construction, representing the first instance of this type of construction for enclosing structural steel work of water towers. It was this that necessitated the deep piling for foundation work.

Costs

The sum of $161,500 was expended for the concrete building structure, exclusive of that which would have been required for the elevated tank in any case. This figure includes the complete offices with the necessary heating, plumbing, air conditioning, electrical work and the specially designed furniture.

The deep well expense totaled $26,000; the cost of pumping and softening equipment was $85,000; the spur track and electric utilities amounted to $10,600. The entire project including engineering and interest during construction totaled $1,325,000.



Pump Room Beneath Lake's City Hall-Water Tower. Deep-well with Lane-Northwest pump in background, Allis-Chalmers high-service pump in foreground

(In between is E. J. Voelker, Sup't. of Water at Lake.)

THE PRESENCE OF COLIFORM BACTERIA IN CHLORINATED WATER

Some Observations in Laboratory Studies and Plant Practice With Especial Reference to the Influence of Low Temperatures

By GEORGE W. FREIBERG
Chief Bacteriologist
ANHEUSER-BUSCH, INC.
ST. LOUIS, MISSOURI

The Author

CONSIDERABLE current interest has been evidenced in the problem of the persistence of coliform bacteria in chlorinated municipal water supplies, and the explanation has been advanced that the presence of coliform bacteria in chlorinated waters might be attributable to a difference in chlorine resistance of different strains of these organisms. That such an explanation might be plausible was suggested by observations similar to those reported quite recently on several strains of *Eberthella typhosa*[1]. Upon the recommendation of the Coordinating Committee of the American Water Works Association a concerted study of coliform bacteria isolated from chlorinated waters is now being conducted in a central laboratory[2].

The large number of cultures which have been referred to the central laboratory for study is ample evidence of the widespread interest in this problem and also indicative of the rather large number of water supply systems which are still confronted with the practical problem of eliminating persistent coliform organisms. Since the presence of coliform bacteria is still the index to sanitary conditions and the potability of the water supply, it is imperative that these organisms be eliminated in order that no confusion may result in evaluating the quality of a chlorinated municipal supply. No concrete statement relating to the control of such organisms in chlorinated water has come to the writer's attention, and it is, therefore, believed that the experience of our laboratory may be of value to those treating water under similar conditions.

General Plant Lay-Out and Operation

In order that the procedure of water treatment may be more readily understood, it is necessary to make a brief statement concerning the general layout of the water treating plant of Anheuser-Busch, Inc., St. Louis, Mo. It consists of the following units:

(1) Pumping station near the Mississippi River, pumping water to No. 1 basin,

(2) Coagulant house, where the lime and coagulant charges are prepared,

(3) Basin No. 1, of one million gallon capacity,

(4) Basin No. 2, of one million gallon capacity,

(5) Basin No. 3, of five million gallon capacity,

(6) Six, one million gallon capacity rapid sand filters,

(7) Clear well of about 400,000 gallon capacity,

(8) High service pumps,

(9) A chlorinator, prechlorination being such that the desired chlorine residual was obtained after the water was delivered by the high service pumps.

Basin No. 1 was used as a settling basin for lime-treated water, but when the turbidity of the raw river water exceeded 2000 p.p.m., Basin No. 1 was sometimes used for presettling to reduce the high turbidity. Basin No. 2 was used as a settling basin for water treated with coagulant when Basin No. 1 was used for lime treatment. When Basin No. 1 was used for presettling, then Basin No. 2 was used for lime treatment. Basin No. 3 served as a reservoir for treated water prior to filtration. Additional settling took place in this basin, and in case Basin No. 2 was used for lime treatment, then Basin No. 3 served as a settling basin for coagulant-treated water.

During the winter months the turbidity of the raw river water may be as low as 100 p.p.m., while during the high water stages the turbidity often exceeds 5000 p.p.m. and may even approximate 10,000 p.p.m. The total hardness of the raw water will vary between 7 and 9 gr. per gal. during the summer and high water stages, and between 15 and 20 gr. per gal. during the winter and low river stages.

The peculiar arrangement and construction of the basins and conduits is such that, in order to obtain an influent filter water of low turbidity (5 to 25 p.p.m.) it was desirable to add sufficient lime to reduce the turbidity in Basin No. 1 effluent to 150 p.p.m. or less. Similarly, enough coagulant was used to reduce the turbidity of Basin No. 2 effluent to less than 50 p.p.m. Additional settling in Basin No. 3 would then result in a filter influent of relatively low turbidity, and a filter effluent of 0.05 to 0.5 p.p.m. turbidity could be realized.

During the summer the temperature of the filter effluent may vary between 75 to 85 degrees Fahrenheit. During the winter, when the basins are covered with ice, the temperature of the filtered water may be in the range of 33 to 35 degrees Fahrenheit. During the winter of 1933-34, coliform bacteria were encountered in the chlorinated filtered water. Even though the residual chlorine ranged as high as 0.5 to 0.8 p.p.m., these organisms survived after 6 to 10 hours exposure to such chlorine residuals.

A natural assumption was that these coliform bacteria might be more resistant to chlorine than strains ordinarily present in the raw water. Regardless of what critical research in the laboratory might show, with regard to the differences between coliform bacteria in their relative resist-

ance to chlorine, we were confronted by the necessity of finding an immediate solution of the problem and obtaining water which would satisfy the prevailing standards of quality.

A study of the plant and laboratory records showed that during the summer, at relatively higher temperatures, no coliform bacteria survived even when very low chlorine residuals were employed. On the other hand, during the winter, when the temperature of the water was only a few degrees above freezing, coliform bacteria survived, provided the lime treated water had some residual bicarbonate alkalinity. That is, when twice the phenolphthalein alkalinity minus the methyl orange alkalinity (the 2P-M value) was negative. If the 2P-M value, or the titration of causticity in the presence of barium chloride, gave a positive value of 0.05 to 0.3 grains per gallon, the coliform bacteria did not survive in the chlorinated water.

New Operating Scheme Developed

Reducing the bacterial count by rendering a water caustic is well known[3], but too caustic water was not acceptable for general manufacturing processes. Consequently, a method of water purification was introduced whereby the coliform bacteria would be sufficiently weakened in the settling basins so that they would succumb to normal chlorination, even at temperatures near freezing.

It will now be necessary to refer back to the general plant layout described above. Ordinarily Basin No. 1 was used for lime treatment, but during the winter when the turbidity of the raw water was very low, the extent of lime treatment was questionable, provided sufficient coagulant was added to Basin No. 2 to effect clarification. Briefly stated, in order to effect a reduction in the resistance of coliform bacteria to chlorination at near-freezing temperatures, it was necessary to use sufficient lime to maintain a 2P-M value of 0.5 to 1.0 gr. per gal. (causticity) in the effluent of Basin No. 1. While this amount of lime treatment may be questioned from the standpoint of simple clarification, particularly since it resulted in pH values higher than those in the most effective floculation range for alum, the advantages derived from such high lime treatment were manifested in the removal of most of the temporary hardness and in attenuating the coliform bacteria.

The effluent from Basin No. 1 was treated with coagulant. Alum, which had been used for years in this plant, was replaced with ferric sulphate ("Ferrisul") in the spring of 1935. The peculiar construction and arrangement of basins and conduits in our plant tended to destroy the alum floc, while a floc less subject to fracture resulted with ferric sulphate. The amount of coagulant used was kept as low as possible (less than 0.3 gr. per gal. in the case of ferric sulphate) in order that the 2P-M value of the effluent of Basin No. 2 would be maintained at 0.3 to 0.5 gr. per gallon.

As the water passed through Basin No. 3 and the filter plant, there was a further reduction of the 2P-M value. Pre-Chlorination was practiced in the filter plant, all the chlorine used being applied in this manner. The 2P-M value of the filter effluent was maintained at 0.0 to 0.3 gr. per gal., never being permitted to become a negative value. Whenever the 2P-M value was allowed to become negative for short periods coliform bacteria persisted in the chlorinated water even though the chlorine residual was 0.5 p.p.m. or more. Such findings pointed to an insufficiently long subjugation of the coliform bacteria to the higher alkaline treatment at the near-freezing temperatures.

A water of the character described above will be encrusting and special responsibility devolves upon the filter plant operator to keep the filter bed in proper condition[4]. Recarbonation was not practiced because this would involve critical control to assure a water which would not be corrosive for pipe lines, condensers, etc. The so-called "Threshold Treatment"[5] with hexametaphosphates had not been developed at the time these initial tests were made. We recognized the more effective bactericidal action of chlorine at lower pH values[6, 7] and under other conditions[6], but we were of necessity limited to obtaining a non-corrosive water, coliform free, under the conditions obtaining in a water purification plant during the winter season.

From a practical standpoint plant operations, as presented above, indidated that coliform bacteria could be eliminated from chlorinated water if the 2P-M value was kept positive and the bacteria weakened or rendered more susceptible to the bactericidal action of chlorine. Nevertheless, additional proof was desired that this assumption was correct, and the question of differences in strains to chlorine treatment was still unanswered. Consequently a series of laboratory experiments were performed.

Laboratory Investigations

On January 13, 1934, a typical strain of *Escherichia coli* was isolated from water showing a chlorine residual of 0.7 p.p.m. with the orthotolidine test. It was our intention to compare this strain with a normal *Escherichia coli* culture, but the question arose, what is a "normal" or "standard" *Escherichia coli* for chlorination studies? Nevertheless, a stock culture* was used for comparative studies.

In the initial tests, suspensions from 24-hour agar slant cultures were added to waters containing different amounts of chlorine. At intervals, cultures were made from these waters into nutrient broth and the presence or absence of growth noted. In these initial experiments, the test culture was noticeably more resistant to chlorine than the stock culture. Experiments were then performed to determine the quantitative survival of bacteria. These experiments indicated that there was no difference between the test culture and the stock culture, but by this time the test culture had been cultured in the laboratory for several weeks.

From these preliminary tests, and other observations, it was obvious that cultural history and physiological conditions were most important in studies of this character. Unfortunately these investigations could not be continued at the time, and it was not until the winter of 1938-39 that, due to changes, coliform bacteria appeared, especially when the 2P-M value of the filtered water was permitted to become negative.

While the encrusting property of a water might be reduced by recarbonation, it was imperative that the water should not be rendered corrosive, and the removal of coliform bacteria had to be accomplished at the point at which the water was most likely to be stable and under the physiological conditions obtaining at the time. In order to approximate such conditions, unchlorinated water was obtained from a filter effluent pipe, powdered calcium carbonate was added to stabilize the water, a certain amount of chlorine water added to give the desired chlorine residual, and cultures made at intervals to determine the disappearance of viable coliform bacteria.

In the initial experiments a sufficiently large quantity of water was prepared as indicated above, and samples were removed at intervals for culturing. However, in order to

* A stock culture of **Esch. coli** (labeled 16 PPc Winslow) had been obtained from the laboratory of Dr. F. W. Tanner, University of Illinois, Urbana, Ill., November 10, 1933.

obtain a representative sample it was necessary to agitate the water to obtain a uniform suspension of the calcium carbonate. Due to the absorption of air and carbon dioxide there was a gradual change in the hydrogen ion value, and while the sample cultured may have represented a "stabile" water at any point, there was a gradual change of the physiological conditions under which chlorination was proceeding. The following is representative of the experimental procedure finally adopted.

Experimental Procedure

About a gallon of unchlorinated water was obtained from the effluent line of a filter. Cultures were made from this water, and then 10 grams of powdered calcium carbonate was added to stabilize the water and the sample cooled to approximately 35 degrees Fahrenheit. Chlorine water, or an aqueous extract of a hypochlorite, was then added to the cold water to give the desired chlorine residual, the ortho-tolidine test sample being warmed to 80 degrees Fahrenheit. Series of test samples were then poured, each series comprising 15 to 20 flasks. Fifty cubic centimeters of water with suspended calcium carbonate were poured into each sterile 250 c.c. Erlenmeyer flask, the cotton plug was replaced with a sterile rubber stopper and the flask placed immediately into a water bath of the desired temperature. After any certain period of time flasks were cultured by adding 75 c.c. of Lauter-Dominick medium, replacing the rubber stopper with a sterile cotton plug and incubating at 37 degrees Centigrade for 48 hours or longer. All flasks showing gas or growth were sub-cultured on Endo plates and the presence of coliform bacteria noted. Thus a series of 20 flasks at three temperatures, 33 degrees Fahrenheit (ice pack), 40 degrees Fahrenheit (ice box), and 70 degrees Fahrenheit (temperature regulated room), required 60 pourings of 50 c.c. each from the calcium carbonate-containing, chlorinated original sample.

The calcium carbonate was added to stabilize the water and represented the lowest hydrogen ion concentration to which recarbonation could be practiced, if desired, to maintain a non-corrosive water and at which chlorination had to be carried out[8, 9, 10, 11]. In culturing the flasks successively by simply adding the Lauter-Dominick medium with a sterile graduate, at 15-minute, 30-minute or 60-minute intervals, the total period required for chlorination could be determined.

When original waters were examined in duplicate or several waters of different composition or treatment, or inoculated waters, were tested, the total flask cultures handled during the day frequently numbered from 100 to 175*. Hydrogen ion and chlorine determinations, and the usual titrations, were made at appropriate stages of the experiments. While different waters would "stabilize" at different pH values and the effectiveness of chlorination at different pH values was recognized, most waters were used as such because they represented more nearly the water which would actually be used in manufacturing operations.

In addition to the factors of hydrogen ion concentration, free causticity, temperature, chlorine residual, and time of exposure to chlorine, there was the factor of the length of time of exposure of the organisms to alkaline conditions prior to chlorination. In order to simulate plant operations, series of experiments were performed in which waters of varying degrees of 2P-M values were inoculated with Esch. coli or other organisms and the waters held at 33 degrees or 40 degrees Fahrenheit for 24 to 48 hours, the water then stabilized with calcium carbonate, chlorinated and cultured in 50 c.c. quantities as described above. At the same time such waters were chlorinated and cultured, a control set was cultured using the same water but adding the bacteria just before chlorination and without previous exposure of the bacteria to varying alkaline conditions at low temperatures. The results of such a series is given in the accompanying table.

*The writer wishes to acknowledge the assistance of Dr. John Rehm in connection with the enormous amount of culture work involved, and the assistance of Mr. Wm. Mullis in connection with other features of these experiments.

Significant Findings

The table presents extreme values in some respects in this particular experiment, but it illustrates the general principles involved in all these experiments. For example a high residual chlorine was used in this experiment and the differences in the 2P-M values were rather extreme. Nevertheless, in spite of the lower pH of water No. 1, the time for chlorination at the lower temperature was very noticeably longer than for the water in which a positive 2P-M value was maintained.

Most significant are the results in the case of water No. 3 where the Esch. coli test culture was added just before chlorination and the organisms survived for more than 15 hours at low temperatures. In some experiments in which the chlorine residual was less, the control sample would give positive cultures 24 hours after chlorination at low temperatures. The practical significance of this is that in certain plants where there may be a great deal of short-circuiting of water in the basins or where the "skimming" of the basins is at a high rate when pumpage is high, the organisms may be subjected to a relatively small degree of attenuation by alkaline or positive 2P-M conditions. Consequently, the 2P-M values would have to be maintained sufficiently high in the basins to accomplish the desired effect without rendering a water too caustic for general purposes, or possibly the causticity and pH would have to be readjusted before the water left the filter plant.

Operating Procedure Selected

Referring again to the general plant layout previously described, the total capacity of the basins is about seven million gallons. Pumpage varied from about one and one-half to three million gallons daily in the winter, and from two and one-half to four and one-half million gallons daily during the summer. The average for the entire year was about three million gallons daily. The total basin capacity is not an indication of the actual retention of "raw" water within the basins. Unless there is considerable skimming, the process of

DATA CHARACTERISTIC OF TEMPERATURE—CAUSTICITY—RESIDUAL CHLORINE RELATIONSHIPS TO PERIOD OF CONTACT REQUIRED FOR E. COLI KILL

Water Sample	Alkalinity gr./gal.			pH of Water		Hours Exposed (40°F.) before chlorination	Residual Chlorine p.p.m.	Length of time required for chlorination (hours)		
	P.	M.	2P-M	Original	Stabilized			33°F.	40°F.	70°F.
1	0.7	2.9	—1.5	9.11	8.73	48	0.6	2.5	1.5	less than 1 hr.
2	1.8	3.1	0.5	10.10	9.70	48	0.6	less than 1 hour		
3	1.8	3.1	0.5	10.07	9.70	0	0.6	15+	15+	3.5

sedimentation would be greatly disturbed, but this also implies that coliform bacteria would pass or "short circuit" from one basin to another with varying degrees of exposure to alkaline (2P-M) conditions, depending upon the rate of pumpage. Furthermore, during the winter, when the basins are covered with or contain ice, there may be a certain degree of "channeling" for the surface waters which would tend to lessen actual retention in the basins still more. Therefore, we have found it desirable during winter months to maintain a 2P-M value on the effluent of Basin No. 1 of 0.5 to 1.0 gr. per gal. even though the turbidity of the raw water may be low. The effluent of Basin No. 2, which represented the coagulant-treated water, was maintained at a 2P-M value of 0.2 to 0.5 gr. per gal. After the water passed through Basin No. 3, this would yield a filter effluent of 0.0 to 0.3 gr. per gal. 2P-M value. Chlorination would then eliminate the coliform organisms even at near-freezing temperatures.

As suggested by the table, all the experiments indicated that even active coliform bacteria were killed when the temperature is high (summer conditions) and a reasonable chlorine residual (0.1 to 0.3 p.p.m.) was maintained for a reasonable length of time (30 minutes to several hours). Thus we have experienced no difficulty with coliform bacteria during the warm months of the year.

Concerning Chlorine Residuals

We believe a brief statement with regard to chlorine residuals is in order. During the winter months we have carried the residual from 0.3 to 0.5 p.p.m., using the ortho-tolidine test. We have a certain distrust of low residuals because, in certain waters the residual obviously was not a true estimation of chlorine treatment. For example, if ortho-tolidine was added to the water and this test sample then warmed to, say 70 degrees Fahrenheit, a residual of 0.2 p.p.m. was indicated, but if the cold water was first warmed to 70 degrees Fahrenheit and after some time, say 30 minutes to 1 hour, the ortho-tolidine was added, the residual indicated would be a trace or less than 0.1 p.p.m. Whether or not this may be described as a delayed "chlorine demand reaction," the general significance of such reactions and observations are undoubtedly important when considering bactericidal action during chlorination. Consequently, we have preferred to carry rather high residuals (0.3 to 0.5 p.p.m.) during the winter months.

Observations in connection with another series of experiments may be of significance in considering chlorine residuals. Experiments intended to yield information on the effect of different 2P-M values at higher temperatures were started, some of the water being kept at 33 degrees Fahrenheit or 40 degrees Fahrenheit and some at 70 degrees Fahrenheit to simulate winter and summer temperatures. The water kept at 70 degrees Fahrenheit showed such a large increase in bacteria other than coliform organisms that it was not considered a proper representation of operating conditions. As a matter of possible technical interest, controls were introduced which consisted of the water being sterilized and the suspension of the test culture of Esch. coli being added. After the usual retention period of 48 hours, then stabilization with calcium carbonate followed by chlorination, the periodic cultures showed that, (1) chlorination was more effective in the previously sterilized waters, and (2) that in the unsterilized waters the Esch. coli was killed sooner than the other coliform bacteria carried over in the original water.

The chlorine residuals employed in the above experiments were 0.4 p.p.m. However, we suspect that sterilization of the water rendered the water more amenable to subsequent chlorination and that the residual, as determined with ortho-tolidine, represented more nearly the active or disinfecting capacity of chlorine, while in the unsterilized waters the residual chlorine value was, at least in part, a false indication of available chlorine, i.e., chlorine loosely combined with the "water constituents," of little immediate disinfecting value, but readily liberated in the ortho-tolidine test.

In these experiments an Esch. coli test culture was used which had been isolated February 11, 1939. When this culture was compared with our stock culture of Esch. coli (PPc Winslow), which had now been maintained in our laboratory for about five years, no tendency toward chlorine resistance was discernible. In order to eliminate the possible factor of changes in a culture when carried on laboratory media, the above experiments were repeated using as inoculant for the various waters a portion of a 24-hour culture of filtered, unchlorinated water in Lauter-Dominick media showing good gas production (and finally proved positive for typical Esch. coli). These waters, inoculated with such a mixed 24-hour culture, showed results similar to those indicated in the table presented in the first part of this paper, except that there was an indication that the typical Esch. coli was killed sooner than the other lactose fermenting organisms. We purposely limit ourselves to this very general statement in view of the excellent technical investigations which have appeared recently with reference to coliform bacteria in general[2, 12, 13, 14, 15] and the identity of these bacteria. We recognize that anything more than such a very general statement requires critical studies and that in dealing with different waters these technical questions are correspondingly multiplied. We feel however, that it should be mentioned at this time for the following reasons.

Discussion

If standards of sanitation and potability are based primarily on the coli index, the filter plant operator is at a disadvantage because, from the practical standpoint, a positive presumptive test is not sufficiently definitive within the time period of his operations. If lactose fermenting coliform bacteria in general are a more feasible index of sanitation and potability, then the rapid "presumptive test" may be a competent guide to the plant operator. The significance of the presence of coliform organisms other than Esch. coli may not be a question which can be answered summarily, particularly for all seasons and for all waters. Of necessity, the plant operator must treat his water supply within the time limits occasioned by consumer demands and purification plant capacity, and if the presence of coliform bacteria other than Esch. coli may be of sanitary significance, the operator requires a positive and rapid test for his guidance in order that he may treat his water in such a manner as to obtain negative "presumptive" tests for any coliform bacteria. Perhaps no universally applicable statement is possible with reference to the significance of all coliform bacteria for all seasons and all waters, which would tend to confuse the operator still more and would leave him little choice other than to treat water in such a manner as to obtain negative "presumptive" tests for *all* coliform bacteria.

While certain general procedures may be applicable to all or most water purification plants, it is apparent that each plant may have certain peculiarities requiring specific or detailed control in order to eliminate what may be regarded as conflicting results[16, 17], which conflicts may be apparent rather than real. We have regarded

our water purification plant as a specific entity with its own individualistic peculiarities and problems. By recognizing the physiological factors attending water purification the differences between winter and summer conditions, the attenuation of coliform bacteria by pH or 2P-M values, in particular the short-circuiting which results in rapid passage of some bacteria through the system and consequently inadequate exposure to conditions in the basins, chlorination adapted to the season of the year which means primarily temperature relations, sufficient retention after chlorination, and the introduction of a suitable medium (in our case Lauter-Dominick medium) for presumptive tests, we have been able to control the presence of coliform bacteria in our water supply.

Conclusions

On the basis of the information discussed above we submit the following conclusions:

1. While different strains of Esch. coli isolated at different times may show slight differences, if any, in resistance to chlorine, this difference is relatively unimportant in the light of other physiological conditions obtaining in purification plant operations.

2. Other coliform bacteria may be more resistant to chlorination than Esch. coli, and unless a distinction is made between Esch. coli and other organisms, both as to identity of organisms and their significance in sanitation and water purification, confusion will certainly result.

3. The practical operator cannot engage in classical studies of the coliform bacteria and he is virtually obligated to follow a treatment which will assure negative "presumptive" tests.

4. The principal physiological factors were temperature relations and rendering the coliform organisms more susceptible to chlorination by subjecting them to a positive 2P-M condition during clarification procedures.

5. Coliform bacteria not subjected to positive 2P-M conditions will resist chlorination for hours at near-freezing temperatures. Therefore, short-circuiting or rapid "skimming" of clarified water in the basins may introduce coliform organisms into the filter plant which will resist chlorination for as much as 24 hours at low temperatures.

6. Depending upon plant construction, the amount of short-circuiting, and the rate of pumpage, the 2P-M value must be adjusted and correlated with the temperature relations and retention after chlorination to effect a reduction of resistance sufficient to assure coliform free water.

7. During low temperature seasons, a chlorine residual approximating 0.5 p.p.m. in cold water may be desirable, using the ortho-tolidine test.

8. When the turbidity of the raw water is low, it may nevertheless be necessary to add sufficient lime to obtain attenuation of coliform bacteria and incidentally take advantage of softening reactions.

9. If the use of lime is not resorted to for good and sufficient reasons, then there must be sufficient storage capacity to effect chlorination at the prevailing temperatures and pH values.

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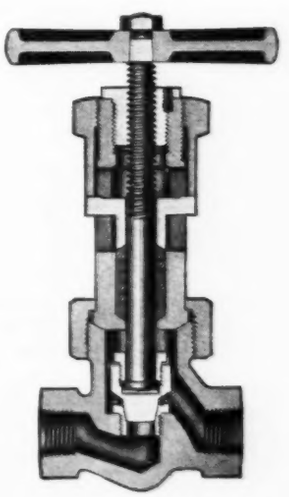
Dependable Valve for Chlorine Service

Water purification and sewage treatment plants using liquid chlorine frequently pipe the dry chlorine gas under pressure from the container to the chlorinator for considerable distance, particularly in those cases where it is desirable to locate the chlorinator at some distance from the most convenient handling point for the chlorine container.

The Pennsylvania Salt Manufacturing Co. has found the Crane Co. 216-P line of valves to be a useful valve for service in chlorine lines conveying either gaseous or dry chlorine. They report that the valve is rugged, constructed of suitable materials to withstand attack of dry, or gaseous chlorine, equipped with deep packing glands, especially fitted for this unusual valve service wherein dependability means much. It is supplied with standard tapered pipe thread connections



and can easily be incorporated into chlorine lines without provision of special fittings.

Persons interested in this valve for chlorine service should make certain that the manufacturer understands that the valve is for chlorine service in order that the packing furnished shall be of a type suitable for chlorine. Before being placed in service, any valve used for chlorine service should be completely dissembled by the user, cleaned of all adhering grease and other extraneous matter, and reassembled in a completely dry state. This is to avoid frozen valves due to chlorination of organic matter, such as greases and oils. (For this information we are indebted to L. L. Hedgepeth, Manager Technical Service Dept., Pennsylvania Salt Mfg. Co.)

EQUIPPING THE SEWAGE PLANT LABORATORY

With Particular Reference to the Smaller Plants

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The Author

SEVERAL excellent articles have been published on the arrangement and functions of large sewage treatment plant laboratories, but very little definite information is available pertaining to a laboratory suitable for sewage plants of from 0.5 m.g.d. to 10.0 m.g.d. capacity. It is the purpose of this article to describe in detail the furnishing, equipping and arranging of a compact laboratory suitable for necessary routine control and statistical determinations.

No discussion will be made of the methods of sewage analysis, or of laboratory technique as these subjects are thoroughly covered in such publications as the "Standard Methods of Water Analysis," published by the American Public Health Association, and "Analysis of Water and Sewage," by Theroux, Eldridge, and Mallman.

The laboratory herein considered is complete in every respect for the average sewage treatment plant, although special conditions or plant processes may require some additional facilities. The analyses which may be performed in the laboratory to be described are:

Solids—Suspended, Dissolved and Volatile.
Sludge—Moisture, Solids, Ash.
Sludge Index (Activated Sludge)
pH—Sewage and Sludge.
Dissolved Oxygen (D.O.).
Bio-chemical Oxygen Demand (B.O.D.).
Oxygen Consumed.
Chlorine Demand.
Residual Chlorine (O-tolidine Method).
Relative Stability (Not Recommended).

Special apparatus has not been provided for sewage gas analysis, nitrogen determinations, or for bacteriological work. Such determinations are not ordinarily a part of routine laboratory work, although many of the larger plants undertake more extensive analyses.

Laboratory Furniture

The scope and arrangement of the laboratory is of prime importance. Many plant laboratories have been laid out and constructed with but scanty appreciation of the facilities required. Since cost is in most cases of great importance, it is the aim of the author to present a laboratory which is compact, entirely complete for the purposes intended, and yet as economical as is possible without sacrificing needed facilities or necessary quality of equipment and apparatus.

Such a laboratory is complete in a room 12 feet wide by 15 feet long. It is based on the experience gained in the author's own laboratory, and in laying out laboratories for other plants.

Certain fundamentals are essential, and must be provided if the worker is to be expected to properly perform his duties. They are as follows:

1. Adequate work table space.
2. A suitable sink with gooseneck faucet with at least 15 inches clearance above sink bottom, and a peg board for draining and drying glassware.
3. A dependable supply of distilled water.
4. An adequate number of gas, air, hot water and cold water hose cocks, and other necessary connections.
5. Fume hood with forced ventilation.
6. Balance table.
7. Electric refrigerator for storing and preserving samples.
8. B.O.D. Incubator.
9. Drying oven.
10. Steam bath.
11. Muffle furnace (for ashing solids).
12. Arrangement for filtration through Gooch crucibles.
13. Cabinets for reagents and solutions.
14. Shelving for small bottles, etc.
15. Cupboard and storage space for glassware, miscellaneous equipment, and supplies.
16. Adequate light, a very important consideration.

Furniture Specifications

Laboratory workers differ in their preferences for wood or steel furniture, and for stone or hard-wood work-table tops. This is not so important, as both have proven satisfactory. A set of detailed specifications are given below which are extracted from the contract specifications for a sewage treatment plant laboratory now under construction. These specifications are for steel equipment, but can be readily adapted to wood furniture if so desired.

1. *Make of Furniture:*—The furniture installed under this contract shall be from a manufacturer who has made at least five satisfactory installations of steel laboratory furniture of materials such as are herein specified, and which installations have been in satisfactory service for two or more years.

2. *Steel:*—Sheet steel shall be of a copper-bearing steel alloy, containing not less than one-quarter of one per cent copper, and shall be hot-lead-coated on both sides, on sheared edges and spot welds so that the steel shall be fully protected against corrosion. All sheets shall be prime grade, stretcher-levelled, free from uncoated

*The Rahway Valley Joint Meeting is the authority which operates the sewer systems and a central treatment works for Rahway, N. J., and eight other participating municipalities.—Ed.

spots, deep scratches or other injurious defects. All drawer heads and cupboard doors shall be of No. 12 gauge thickness; drawers and small shelves shall be of No. 20 gauge, all other sheet steel work shall be of No. 18 gauge. Gauges specified above and elsewhere herein are U. S. gauge.

3. *Cabinets and Supports:*—All cabinet work shall be sanitary, vermin-proof flush type, without recessed or projecting panels. It shall be designed and constructed for laboratory use, with pipe ducts, racks, removable backs, shelves and adjustable legs for levelling.

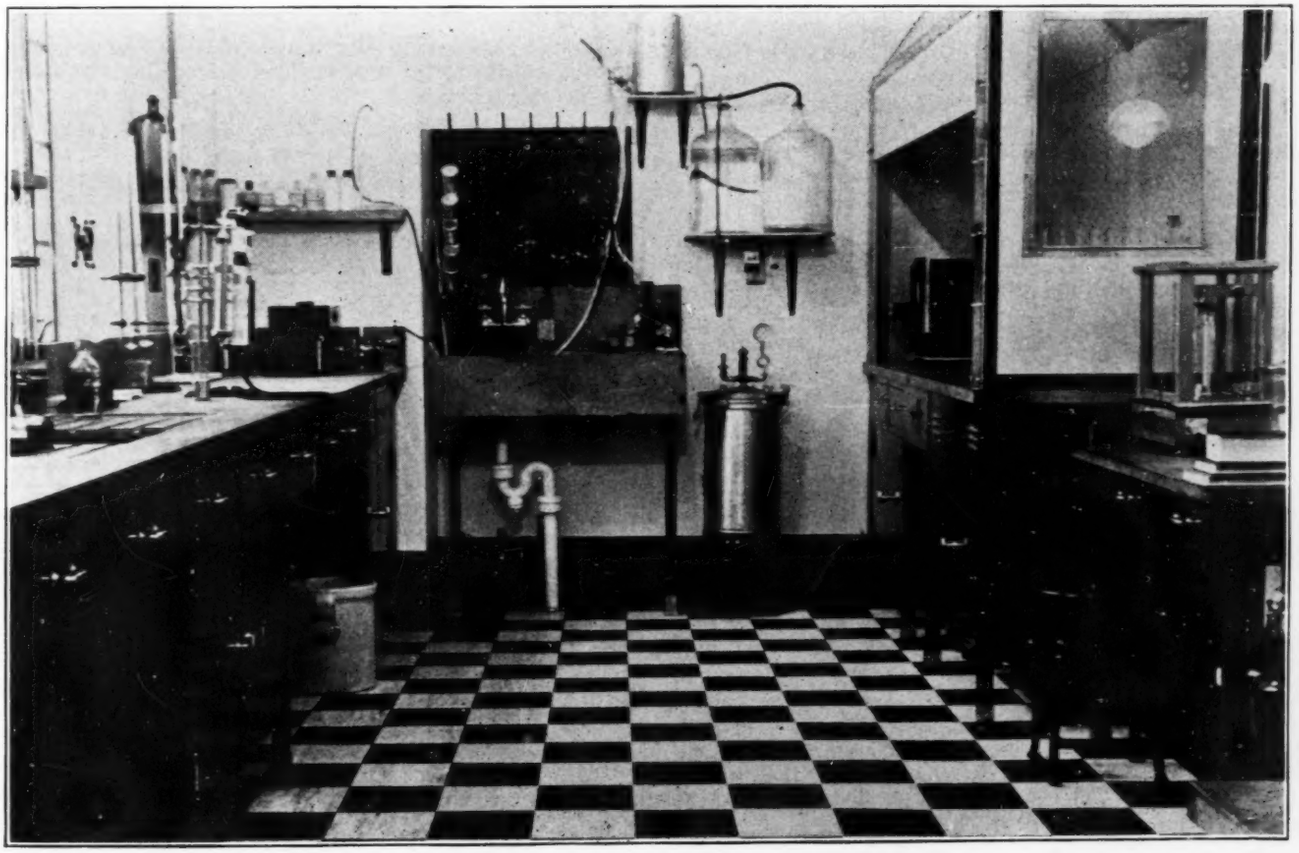
Sides, backs and bottoms of cabinets shall be of No. 18 gauge. Sides of cabinets shall be of one piece, formed into a U-shaped corner post at the front, the inner sides of which shall be formed into a door strike. The upper and lower edges of the cabinet sides and back and front rail shall be formed into a channel member, reinforced with a continuous angle frame of 1¼ x 1¼ x ⅛ inch copper steel, mitered and welded at the corners, to which the legs shall be welded. Backs and shelves shall be removable from the inside so that piping may be installed or removed without dismantling any part of the table. Backs shall fit into clips at the bottom. At the top, the back shall be flanged in a 7/16 inch flange or back panel, and shall be held in place with two screws at the ends.

Legs of cabinets shall be of No. 14 gauge, 1½ inch square seamless tubing, 8 inches high; and shall be acetylene-welded to the angle iron frame of each individual cabinet at the bottom of the cabinet. After the legs are welded to the frame, the frames with the attached legs shall be dipped into a vat of hot lead so that all surfaces and welds shall be fully coated and protected. Each leg shall be fitted with a drive fitting, non-ferrous die-cast, micro-levelling device, with six prongs and clip wells. The shoulder of the levelling devices shall rest on the bottom of the square tube legs, and shall then be permanently attached to the leg by forcing the metal leg into the depression on the device. The shoulder shall extend ¼ inch below the bottom of the leg. Each levelling device shall be fitted with a 2½-inch long hexagonal bolt, cadmium plated and furnished with stainless steel floor plates. The levelling device shall be covered with a duraluminum shoe cover plate as hereinbefore specified.

Cupboard doors shall be of No. 12 gauge, hung on a pair of No. 10 gauge, lead dipped, offset, five knuckle hinges, with round head brass fixed pins and with concealed flaps; one flap shall be blank and welded to the door, the other shall be fastened to the cabinet post with three bolts. Doors shall be provided with a lead-plated three-way locking device, locking both doors at the top, bottom and center at one time by a not less than 2⅜ x 1⅜ inch oval shaped, solid cast aluminum alloy knob with a ⅜ inch square brass stem cast and pinned into the knob engaging a stamped locking cam of No. 12 gauge and two ⅝ x ⅛ inch sliding bolts.

Drawers shall be of No. 20 gauge, the upper edge of the sides and back of which shall be reinforced and formed into a U-shaped head. The front of the drawers shall be of No. 12 gauge. Each drawer shall operate on four ⅞-inch diameter cadmium-plated ball-bearing rollers, operating on extension channel runners. Runners shall be formed of No. 14 gauge, and shall support the drawers rigidly when extended the full length. The drawer stop shall be fastened to the bottom of the drawer, and shall be concealed at all times. Drawer pulls shall be graceful in design and shall be of cast-aluminum alloy, fastened from the inside of the drawers with concealed aluminum alloy screws. The drawer pull shall not extend into drawer.

4. *Hardware:*—All hardware, including the kick-plate shoes, shall be as described under laboratory cabinet construction and shall be of cast silicon-aluminum alloy,



One End of the Laboratory—Rahway Valley Plant

ground and polished to a satin finish. All screws shall also be of same aluminum alloy. All cocks and table fixtures shall be chromium plated.

5. *Finish:*—All surfaces of steel work of laboratory equipment shall be first washed clean with benzine to remove all the oil and grit. Then one coat of neutral metallic filler shall be applied, baked and sanded; then one coat of rust preventing primer baked and sanded; finally two coats of dark green acid and alkali resisting enamel shall be applied.

6. *Main Work Table:*—The main work table along the front wall of the laboratory (see plan) shall be 15 feet long (approximately) by 2 feet 6 inches wide by 37 inches high. The table top, the 6-inch high back, and the 4-inch cut-out at the window shall be of 1¼-inch soapstone. The sink in the table shall be 18 x 16 x 8 inches deep, and furnished with a Duriron waste fitting. The table shall be supported on complete combination drawer and cupboard units, with a 5-foot clear opening in front of the window. Drawers shall be provided for the full length of the table, with a dummy drawer in front of the sink to match the rest of the equipment. A 12-inch deep open shelf shall be provided across the clear opening in front of the window, with flange-up back and flange-down front. It shall be mounted at the bottom of the cupboard, and toward the rear of the opening.

7. *Vacuum Manifold:*—The table shall be equipped with one vacuum manifold fitted with four 3-way exhaust cocks and one 3-inch dial vacuum gauge. The manifold shall be mounted on suitable supports at the back of the table, and connected to the vacuum pump cock by means of flexible copper tubing with compression type couplings.

The 3-way cocks shall be fitted in the side of the manifold facing the front of the work table.

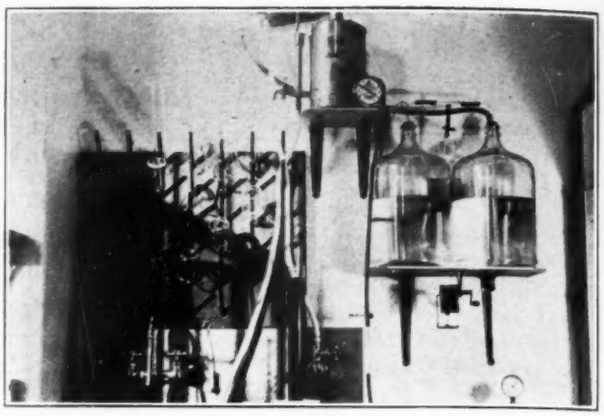
8. *Fittings for Main Work Table:*—The sink shall be fitted with one combination hot and cold water goose neck drop faucet with hose end, the goose neck to be of such height as to clear 1000 ml. graduated cylinders. A cold water faucet shall also be provided, same to have a screw-type opening suitable for a Chapman aspirator. The table shall also be equipped with one pedestal type single air pressure cock, three pedestal type double gas cocks, and one pedestal type cold water cock.

9. *Vacuum Pump:*—There shall be installed on the shelf of the cabinet space under the sink a suitable blower and vacuum pump for the operation of the vacuum manifold. These conditions are satisfied by a Cenco Rotary air cooled blower and vacuum pump driven by a ¼ horsepower motor mounted on a common base. (The electrical current characteristics must be given for the motor). The motor shall be controlled by a push-button switch located at a convenient point on the wall above the main work table.

The vacuum side of the pump shall be connected with ¼-inch copper tubing, or extra heavy vacuum rubber tubing, to the exhaust manifold as indicated on the drawings. The pressure or exhaust side of the pump shall be connected to the air cock on the main work table with ¼-inch copper tubing.

10. *Work Table Shelving:*—There shall be furnished and installed on the wall above the main work table, 1¼-inch thick by 6 inches wide soapstone reagent shelving mounted 22 inches above the top of the work table. The shelves shall extend along all walls of the work table, except for the window and peg board. The shelves shall be supported on suitable brackets, securely fastened and anchored to the building wall.

11. *Peg Board:*—There shall be mounted on the wall at the right end of the work table a peg board of carbonized wood, 24 inches wide by 30 inches high.



Peg-board Above Sink and Water Still on Right

12. *Fume Hood:*—The fume hood shall be an open type fume hood 5 feet long by 2 feet 6 inches wide. The work table of the hood shall be supported by one 2½-foot combination drawer and cupboard unit. The hood shall be furnished with one 1000-watt pedestal-type duplex electric receptacle, two pedestal-type double gas cocks, one pedestal-type double water cock, and one four-hole gas-heated steam bath.

The steam bath shall be fully insulated, with a gas vent opening on the inside of the fume hood. The steam bath shall be constructed of No. 18 gauge stainless steel, and equipped with stainless steel concentric rings to cover the four 3¾-inch diameter openings. The bath shall be of the quick-steaming type, equipped with a suitable external water level regulator. A Hoke-Phoenix needle valve shall be used to control the water supply to bath, and the bath overflow shall be visible.

A suitable opening and connection shall be provided through to the top or rear of the hood for the installation of the exhaust fan.

13. *Hood Exhaust Fan:*—A suitable exhaust fan shall be installed to exhaust the fume hood. The fan shall have a capacity to discharge not less than 225 cubic feet of free air per minute at free delivery.

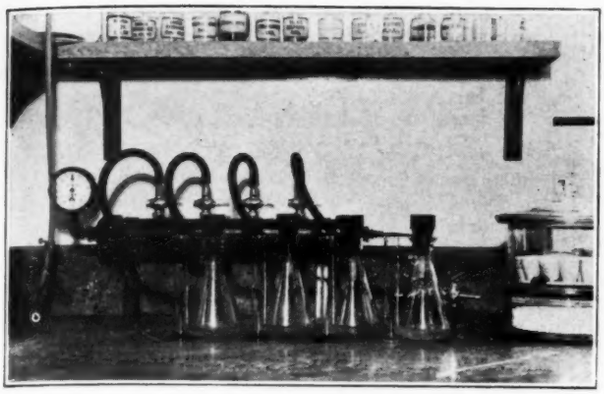
The fan suction and discharge piping shall be of suitable acid fume resisting material, such as "Labite," "Transite" or vitrified tile. All joints shall be air tight, and the joints at the fan shall be made with high-grade, heavy rubber tubing to prevent vibration.

The exhaust piping shall terminate at the roof in a suitable size ceramic ventilating roof cap, properly flashed to the roof.

14. *Other Shelving:*—There shall be furnished and installed the necessary shelving for the water still and the two 5-gallon distilled water carboys. If possible, the water still can be mounted on top of the reagent cabinet. The shelf for the 5-gallon carboys shall be of ⅜-inch Labite or Transite, 22 inches wide by 11-inches deep. It shall be mounted on heavy brackets of sufficient strength to carry the weight of the bottles, when full.

All brackets shall be securely fastened and anchored to the building wall.

15. *Balance Table:*—The balance table shall be 5 feet long by 1 foot 9 inches wide by 2 feet 7 inches high, and shall be constructed of 1⅝-inch diameter tubular steel with a cross bar at rear only to provide ample leg room. The floor flanges shall be such as to permit levelling of the table. A 4-inch high panel shall be provided under



Vacuum Manifold and Filter Flasks
(Used in determination of total suspended and settleable solids. On right Gooch crucibles in desiccator.)

the table top into which shall be fitted two small drawers. The table top shall be of 1¼-inch selected soapstone.

16. *Reagent Cabinet:*—There shall be furnished and erected an enameled steel reagent cabinet, 7 feet high and of suitable length, and 6 inches clear depth. The cabinet shall be constructed of No. 18 gauge steel with sliding steel doors glazed with No. 1 clear glass. The cabinet shall have five shelves, adjustable in height. The cabinet shall have three front legs, with provisions for bolting the cabinet securely to the wall.

The approximate cost of the laboratory furniture specified above is $1,250.00.

Permanent Apparatus

In addition to the laboratory furniture, certain permanent apparatus will be required. The following list of this apparatus, as well as the "Minor Equipment Items" list and the "Reagents and Chemicals" list, has been carefully compiled, and checked against the equipment and experience of active plant laboratories. The "loading up" of the laboratory with unnecessary or little-used apparatus and equipment has been avoided. Enough equipment has been included to enable the chemist or operator to walk into the laboratory and commence work without the all-too-customary wait for necessary items, not originally included.

In the preparation of such lists, cognizance is taken of the fact that certain manufactured items of equipment and apparatus have been found to be the most satisfactory for use in a sewage plant laboratory. It is also recognized that a general description of a particular item without the corresponding manufacturer's name or catalog number will not always enable a purchaser to obtain the article intended. Therefore, wherever deemed advisable, the manufacturer's name or dealer's catalogue number is included in order to eliminate errors in the purchase of this equipment. Wherever possible, more than one manufacturer or dealer will be given.

The following abbreviations will be used throughout for several of the more prominent supply houses:

Arthur H. Thomas Company....AHT
Eimer & Amend.....E&A
Central Scientific Co.....CSC

The catalog numbers thus given can be considered as standards of quality by which other competing houses can offer their merchandise.

Quantity	Description
1	B.O.D. Incubator 5 to 6 cu. ft. capacity (give current characteristics).
1	Analytical Balance with chain balance with channel notched beam, sensitivity to 1/20 mg. with magnetic damper, Christian Becker chainomatic No. 16, or E&A 16772/2.
1 set	Analytical Balance weight, 1 gm. to 100 gm. for chain balance.
1	Rubberized Balance Cover to fit balance.
1	Triple Beam Balance with agate bearings, including sliding weights and 500 gm. and 1000 gm. attachments. Equal to E&A 17026, 17026 A&B, or CSC 3600 & 3610.
1	Beckman pH Meter (Industrial Model).
1	Taylor-Enslow Slide Chlorimeter (where chlorine is being used).
1	Muffle Furnace, MU Type 62 Electric and Encased Rheostat (give current characteristics).
1	Electric Drying Oven, inside dimensions approximately 12" x 12" x 15" with inside glass door. Elconap Type BO 15, or Weber Type B (give current characteristics).
1	½ gallon per hour Automatic Water Still, as made by either Barnstead or Stokes. May be for electricity or sewage gas. If for electricity give current characteristics.
1	International Clinical Electric Centrifuge with a 4-place combination head for two 15 ml. tubes and two 50 ml. tubes (give current characteristics).
4	15 ml. graduated resistance-glass conical-bottom centrifuge tubes.
4	50 ml. graduated resistance-glass centrifuge tubes with spouts, E&A 20065/4.
1	5 cu. ft. standard make electric refrigerator.

The approximate cost of the permanent apparatus listed above is $1,110.00.

It is possible to substitute cheaper equipment for some of the items specified, but such substitutions will inevitably result in frequent breakdowns and repairs, and unsatisfactory results. After all, the old axiom that "a workman is as good as his tools" holds good in a sewage plant laboratory a well as in a shop.

The centrifuge listed above is not absolutely necessary, but has been found to be very useful for controlling the drawing-off of supernatant liquor from digestion tanks, and in the operation of activated sludge plants.

Some chemists and plant operators still use colorimetric apparatus for pH determinations. However, a potentiometer, such as the Beckman pH Meter, specified above, is not only more accurate, particularly with sludges, but is also a great time saver to the busy worker.

Minor Equipment Items

This list includes all minor and renewable items such as glassware, brushes, burners, rubber tubing and stoppers, etc. Sufficient glassware is included to allow for reaonable washing intervals.

Quantity	Description
1	Actigel Analytical Balance Desiccator.
1	Fruhling & Shultz Desiccator, 10-inch, with cover and 10-inch Coors porcelain perforated plate.
1	Fruhling & Shultz Desiccator, 8-inch, with cover and 8-inch Coors porcelain perforated plate.
2	Balanced Watch Glasses, 3-inch (1 pair).
	Beakers, No. 1000 Pyrex Griffin low form with lip.
2	1000 ml. capacity
2	600 ml. capacity
4	400 ml. capacity
12	250 ml. capacity
6	100 ml. capacity
4	50 ml. capacity
	Bottles, Narrow Mouth, Flint Glass, round, for corks, AHT 2203, E&A 18652.
12	12 oz. capacity
12	8 oz. capacity
18	300 ml. B.O.D. Bottles, glass-stoppered with stoppers numbered consecutively from 1 to 18 to correspond with numbers on bottles. Numbering to be in black enamel figures. Bottles to be of Non-Sol-Vit glass, and not over 6½" in height, including stoppers. (18 bottles will permit two determinations weekly on raw sewage and effluent).
	Bottles, Narrow Mouth, glass stoppered tincture, with well ground flat stoppers, AHT 2220 or E&A 18680.
12	1000 ml. capacity
24	500 ml. capacity
12	250 ml. capacity

4 30 ml. Round Dropping Bottles with flat, grooved stoppers, AHT 2257 or E&A 18824.
4 30 ml. Square Dropping Bottles with rubber bulb stoppers and glass pipette, E&A 18806.
1 Washing Bottle, 1 liter Pyrex complete with rubber stopper, glass tubes and rubber tubing joints.
4 5-gallon Narrow Mouth Glass Bottles, E&A 18650 (for distilled water).
6 2-gallon Narrow Mouth Glass Stoppered Bottles, AHT 2210-A (for B.O.D. dilution water and standard solutions).
4 1-gallon cider jugs (for compositing and storing samples).
1 Superior quality camel hair brush with wooden handle and ½-inch. dia. tuft., AHT 2376 or E&A 19048 (for dusting scale pans).
6 Medium camel hair brushes, AHT 2378 or E&A 19042 (for cleaning watch glasses).
12 Test Tube Brushes with Puff Tuft end, tinned iron wire handle, 1½-inch diameter bristles, AHT 2389.
1 Cylinder Brush, bristle end, strong rattan handle, bristle 2 inches diameter by 4½ inches long, total length 25 inches, E&A 19072.
6 Pipette Brushes, length of bristles 7½ inches, AHT 2382, E&A 19074.
2 Burette Brushes, brass wire handles, tufted bristle end, AHT 2396.
4 Brushes, of black bristle, total length 12 inches, AHT 2363 or E&A 19092.
3 50 ml. Schellbach Burette with large straight glass stopcock, AHT 2436.
1 50 ml. Schellbach Burette with large three-way glass stopcock, AHT 2438.
2 Fisher Burette Supports, complete with clamps, base 7" x 13" Opal White Glass, nickel-plated support rod, E&A 31915.
4 Fisher High Temperature Burners, AHT 2596 or E&A 19309.
4 Apparatus Supports for Fisher Burners, AHT 2599.
6 Clamps, castaloy, cadmium plated with 1½-inch effective jaw opening, E&A 20195.
3 Heffman Pinchcocks, ¾" x 1⅛", AHT 3270, CSC 12195, or E&A 20294.
6 Mohr Pinchcocks, ⅝ inch opening, AHT 3278 or E&A 20298.
2 Test tube Clamps AHT 3246.
Non-absorbent Cotton (1 pound).
Corks, first quality, assorted in sizes No. 1 to No. 14, E&A 2119 (1 gross).
Cork Borers (1 set 3/16 inch to 13/32 inch), AHT 4068, E&A 21213, or CSC 12465.
6 Vitreosil Opaque Fused Silica Dishes, 100 ml. E&A 22000.
3 Vitreosil High Form Opaque Fused Silica Crucibles, without covers, E&A 21248.
24 No. 270 Coors Porcelain Gooch Crucibles, Size No. 3 (25 ml. capacity) without covers.
4 Crucible Holders, Walter, E&A 23050, to fit the filter flasks, Item No. 38.
4 500 ml. No. 5340 Pyrex Filter Flasks.
1 Crucible Tongs, nickel-plated brass, 12 inches long, E&A 32553.
1 Crucible Tongs, nickel-plated brass, 16 inches long, AHT 9701.
1 Crucible Tongs, cast brass, 8 inches long, AHT 9692.
Cylinders, single graduated Pyrex, AHT 4409, E&A 21652, CSC 16140.
2 1000 ml. capacity
1 500 ml. capacity
6 100 ml. capacity
2 50 ml. capacity
Whatman No. 2 Filter Paper—15 cm. diameter (6 boxes).
Grey Filter Paper, 33 cm. diameter, E&A 23156 (* pkgs.).
12 5-inch Triangular Files, AHT 5083.
12 Pyrex Erlenmeyer Flasks, 250 ml. No. 4980.
Volumetric Flasks, resistance glass with ground glass stoppers (two graduations to contain and deliver), (AHT 5465.
1 1000 ml. capacity
1 500 ml. capacity
1 250 ml. capacity
1 100 ml. capacity
Funnels, Glass, ground rim and thin stem about 10 cm. long ground to a point, AHT 5570, E&A 23622.
4 6.5 cm. diameter
2 10 cm. diameter
1 Ribbed-Glass Funnel, 18 cm. O.D. of rim, E&A 23632, AHT 5584.
2 No. 430 Coors Porcelain Evaporating Dishes, Size No. 2, 120 ml. capacity.
12 Glass Stirring Rods, 3/16", E&A 24562.
Glass Tubing, soft glass, regular wall, E&A 24570.
5 mm. O.D. (2 lbs.)
7 mm. O.D. (2 lbs.)
8 mm. O.D. (2 lbs.)
1 No. 520 Coors Porcelain Mortar & Pestle, Size No. 2 (115 mm. inside diameter).
1 No. 550 Coors Porcelain Spot Plate, Size No. 00 (92 x 112 mm.).
1 No. 624 Coors Porcelain Pipette Rest.
No. 650 Coors Porcelain Spatulas.
1 Size 2, 142 mm. long
1 Size 4, 195 mm. long
1 Bottle Cenco Ceramic Marking Ink, CSC 14000.
No. 37000 Exax Blue Line Transfer Pipettes.
2 10 ml. capacity
3 25 ml. capacity
2 50 ml. capacity
No. 37020 Exax Blue Line Mohr-type Measuring Pipettes.
2 1 ml. capacity
2 2 ml. capacity
2 5 ml. capacity
6 10 ml. capacity
1 Pipette Support, revolving, of hardwood, with 3 decks revolving on wooden base, AHT 8264.
Rubber Tubing, Best Heavy White Wall, ⅛" x ⅛", for automatic still connections, E&A 30683 (12 ft.).
Rubber Tubing, Heavy Red Wall, ⅜" x ⅛", E&A 30703 (12 ft.).
Rubber Tubing, Heavy Red Wall, ¼" x 3/32", E&A 30703 (12 ft.)
Rubber Tubing, ¼" Extra Heavy Vacuum, for vacuum pump and aspirator connections, E&A 30710 (12 ft.).
6 Rubber Policemen, 3/16 inch, E&A 30734.
Rubber Stoppers, Solid, No. 3, No. 4, No. 5, No. 6, No. 7, No. 8, No. 9, No. 10, E&A 30639 (1 lb. of each).
Rubber Stoppers, One-Hole, No. 3, No. 4, No. 5, and No. 6, E&A 30641 (½ lb. of each).
Rubber Stoppers, Two-Hole, No. 3, No. 4, No. 5 and No. 6, E&A 30643 (½ lb. of each).
1 Scissors (7-inch), of good quality.
1 Chapman Filter Pump, 5⅜ inches long, AHT 5286, E&A 30134.
1 Test Tube Support, double deck with 24 holes, 22 mm. diameter, with row of pins in rear, AHT 9509 or E&A 31991/1.
2 Spatulas—4-inch stainless steel blades with rosewood handles, E&A 31048.
Thermometers, AHT specifications, AHT 9525.
1 Graduated— 5° C. to 200° C. (for drying oven).
1 Graduated—10° C. to 110° C. (for B.O.D. Incubator).
1 Wood Frame Thermometer, 0-120° F., E&A 32498 (for sewage temperatures).
1 10-inch Maximum and Minimum Thermometer, self-registering, best make, —40° F. to 120° F., with magnet, E&A 32416 (for recording outside air temperatures).
24 No. 9800 Pyrex Test Tubes, 150 mm. x 16 mm.
6 Triangles, 2-inch sides, E&A 32648.
Watch Glasses, E&A 32850.
12 3-inch diameter
12 4-inch diameter
12 5-inch diameter
12 5" x 5" Tinned Wire Gauzes with flat asbestos centers, E&A 33090 or AHT 9995.
12 Pencils, all-red wax.
1 4-gallon Stoneware Jar, E&A 25634, AHT 6292 (for waste materials).
1 Gas Diffuser Stones, Aloxite Brand, 1-inch diameter, E&A 24167 (for aerating B.O.D. dilution water).
Gummed Labels, Dennison No. 201, No. 209, No. 217, and No. 223 (2 boxes of each).
1 Hydrometer Cylinder, 2" dia. x 15" high, E&A 21630 (for washing pipettes in cleaning solution).
Iron Rings, combined with fasteners for attaching to iron supports, E&A 30620.
2 1¼-inch I.D.
2 2-inch I.D.
2 3-inch I.D.
2 4-inch I.D.
4 Iron Supports, Medium, 20-inch rod, E&A 31879.
Coarse Glass Wool (E&A 24638), for bottom of hydrometer to prevent breakage of pipettes (4 oz.).

The approximate cost of the minor equipment items listed above is $290.00.

Reagents and Chemicals

All reagents to be chemically pure unless otherwise noted.

Quantity	
5 lbs.	Glacial Acetic Acid, c.p.
6 lbs.	Hydrochloric Acid, Spr. gr. 1.20, c.p.
7 lbs.	Nitric Acid, sp. gr. 1.42, c.p.
1 oz.	Oxalic Acid, c.p. crystal.
18 lbs.	Sulphuric Acid, tech.
9 lbs.	Sulphuric Acid, sp. gr. 1.84, c.p.
1 lb.	Aluminum Sulphate, crystal, c.p.
8 lbs.	Ammonium Hydroxide, sp. gr. 0.90, c.p.
1 lb.	Ammonium Carbonate, c.p.
1 lb.	Asbestos, short fibres, acid washed. Powminco.
5 lbs.	Calcium Chloride, calcined, porous, gran. for desiccators, tech.
1 lb.	Chloroform, pure (Squibb).
1 lb.	Copper Sulphate, crystal, c.p.
1 lb.	Ether, Ethyl), U.S.P.
¼ lb.	Iodine, resublimed, c.p.
1 lb.	Lead Acetate, normal, c.p.
5 lbs.	Manganous Sulphate. c.p.
1 oz.	Methyl Orange Indicator.
1 oz.	Orthotolidine powder, c.p.
1 oz.	Phenolphthalein, c.p.
1 oz.	Potassium Biniodate, c.p.
1 lb.	Potassium Chromate crystals, c.p.
5 lbs.	Potassium Dichromate, tech.
1 lb.	Potassium Dichromate, c.p.
1 lb.	Potassium Hydroxide, pellets, c.p.
2 lbs.	Potassium Iodide, crystal, c.p., Bakers Analyzed Special.
1 lb.	Potassium Oxalate Neutral, c.p.
1 lb.	Potassium Permanganate, crystal, c.p.
1 oz.	Silver Nitrate, c.p.
1 lb.	Soda Lime, 4 to 8 mesh.
5 lbs.	Soduim Bicarbonate, crystal, c.p.
1 lb.	Sodium Carbonate, c.p.
5 lbs.	Sodium Chloride, crystal, c.p.
10 lbs.	Sodium Hydroxide, pellets. c.p.
1 lb.	Sodium Acid Sulphite, $NaHSO_3$, c.p.
4 oz.	Soluble Starch, Indicator Grade.
1 doz.	Litmus Paper, 6 red and 6 blue.
1 oz.	Stopcock Grease.
1 lb.	Sodium Oxalate, c.p.
5 lbs.	Sodium Thiosulphate.
¼ lb.	Thymol (to be used as a preservative for Sodium Thiosulphate Solutions).

One quart of pure Ethyl Alcohol should be purchased locally, as the chemical supply houses are not licensed to supply grain alcohol.

The approximate cost of the reagents and chemicals listed above is $60.00.

Summary of Costs

The approximate cost of furnishing and equipping the complete sewage treatment plant laboratory described above is as follows:

1.	Laboratory Furniture	$1,250.00
2.	Permanent Apparatus	1,110.00
3.	Minor Equipment Items	290.00
4.	Reagents and Chemicals	60.00
	Total Cost	$2,710.00

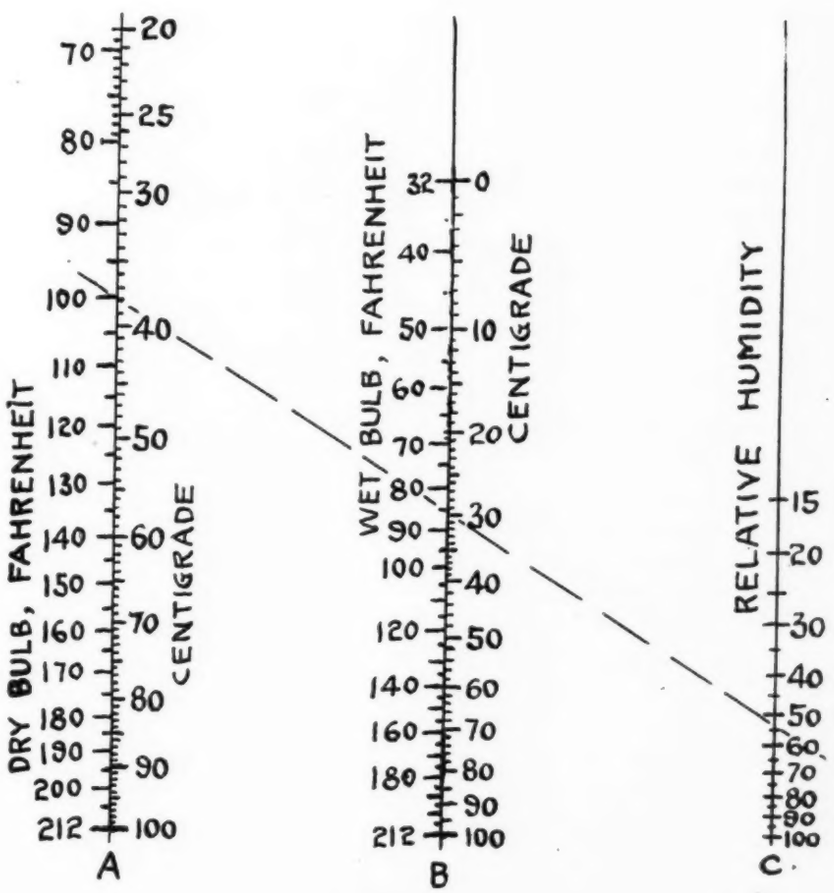
Acknowledgment is given to Mr. Joseph Boreiszo, plant chemist at the Rahway Valley Sewage Treatment Plant, for many helpful suggestions in the preparation of this article.

A HUMIDITY CHART*

Here is a handy chart for assisting water and sewage works operators to quickly find the relative humidity at any time. Tables and computations are unnecessary. Run a straight line through the dry bulb temperature, column A, and the wet bulb temperature, column B, and the relative humidity is instantly given at the intersection with column C. Thus if the dry bulb temperature is 100 deg. F. and the wet bulb temperature 85 deg. F., the dotted line drawn across the chart shows that the relative humidity, column C, is 54%.

The chart is based on a special formula developed by the U. S. Bureau of Standards. The formula has been tested by the Bureau for dry bulb temperatures between 20 and 100 deg. Centigrade. An important advantage of this chart lies in the fact that it gives temperatures in both Fahrenheit and Centigrade.

[The chart also has an additional reference value. The B column serves as a ready chart for converting temperatures from Fahrenheit to Centigrade and the reverse. Its pretty handy when you can't recall the formula for making such conversions. Set up a wet and a dry bulb, and with this useful little chart watch the relative humidity of your office and also your home. It may pay you dividends.—Ed.]



*Contributed by W. F. Schaphorst, Newark, N. J.

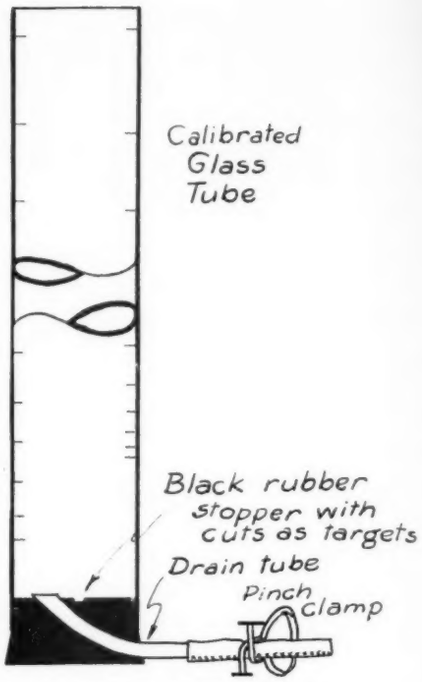
A SIMPLE TURBIDIMETER for FAIRLY CLEAR WATER

By A. A. HIRSCH, Chemical Engineer
New Orleans Sewerage and Water Board
NEW ORLEANS, LOUISIANA

A CHEAP, easy to use, portable device for measuring water turbidities in the slightly turbid range, without the use of prepared standards, can be made readily from a 4½ foot length of 1¾ inch diameter glass tubing as described below and sketched herewith.

This tube is closed on the bottom by a black rubber stopper (size 10) through which is inserted diagonally a glass drain. Over this outlet is slipped a rubber tube on which is a Mohr pinch clump to control the discharge. On the inside surface of the rubber stopper are cut two scratches, one a deep and wide gash about 2½ cm. long by 1½ mm. wide and the other a shorter fine line 1½ cm. long, by not over ¼ mm. wide.

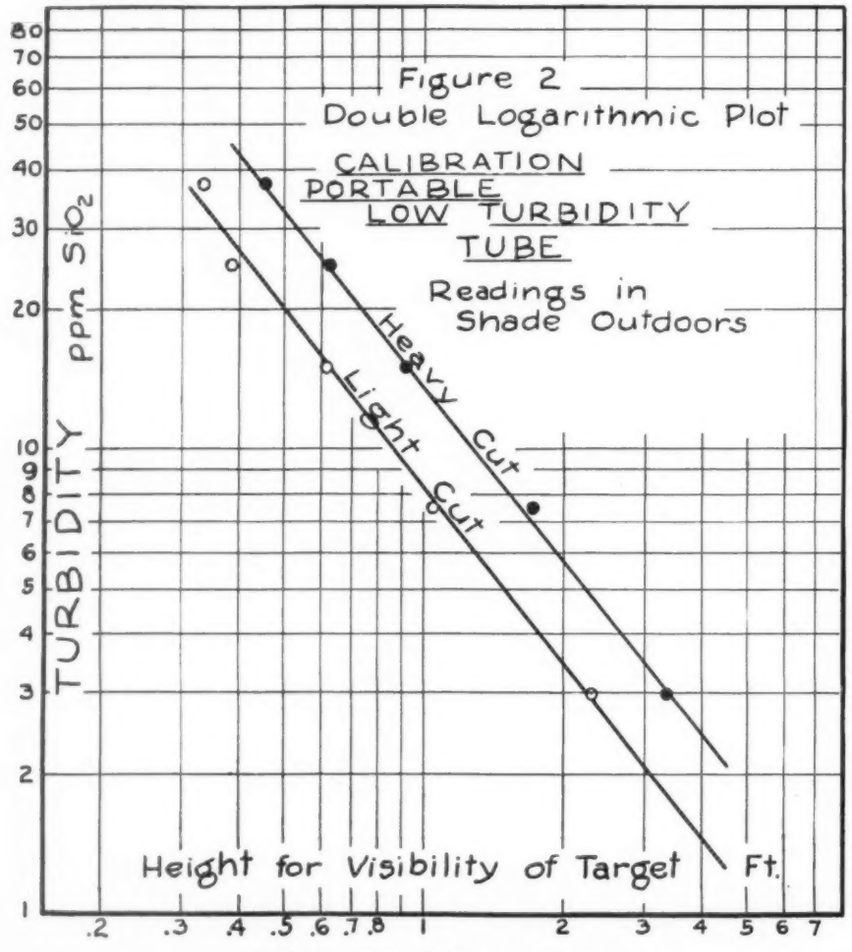
It is desirable to cut these scratches in a simple pattern definitely oriented with respect to the drain tube in order to provide for easy observation. A T-shape design in which the stem is the wide cut and the top bar a fine thin scratch is a good arrangement. Two turbidity scales, cut with a file on the tube to correspond to the two scratches, embrace the turbidity ranges 2½ to 80 p.p.m. and 1½ to 7 p.p.m. for the wide and thin cuts, respectively. Square rubber collars, not shown in the sketch, may be placed on each end of the tube to reduce danger of breakage.



Glass-Tube Turbidimeter

Procedure

To use this instrument the observer completely fills the tube with the sample and looks vertically down through the water column in an attempt to view the scratches. If neither scratch is visible, water is allowed to flow from the tube by opening the pinch clamp on the discharge hose. This act is very conveniently done by using foot pressure to squeeze the clamp while all the time continuing observation through the descending water column until the wide gash just comes into sight. The flow is then stopped by releasing foot pressure on the clamp and the turbidity is read directly from the water level on the corresponding scale. If a check reading is desired the tube is emptied further until the fine scratch becomes visible and the other scale of turbidities read opposite the second water level. When quite clear water samples are examined the fine scratch is watched for from the start.



Turbidity Tube Calibration Curves

Calibration

Calibrations are made, preferably for each particular observer, by filling the tube with suspensions of known turbidity and marking the water level at which the scratches just appear. (Preparation of standard turbidity suspensions are described in Standard Methods of Water and Sewage Analysis.) Another method of calibration is by determining visibility levels of samples evaluated with some accurate type of turbidimeter. Whichever method is chosen, the results are best plotted on double logarithmic paper for smoothing out, as here illustrated.

Appearance levels for various turbidities are then marked directly on the glass tube.

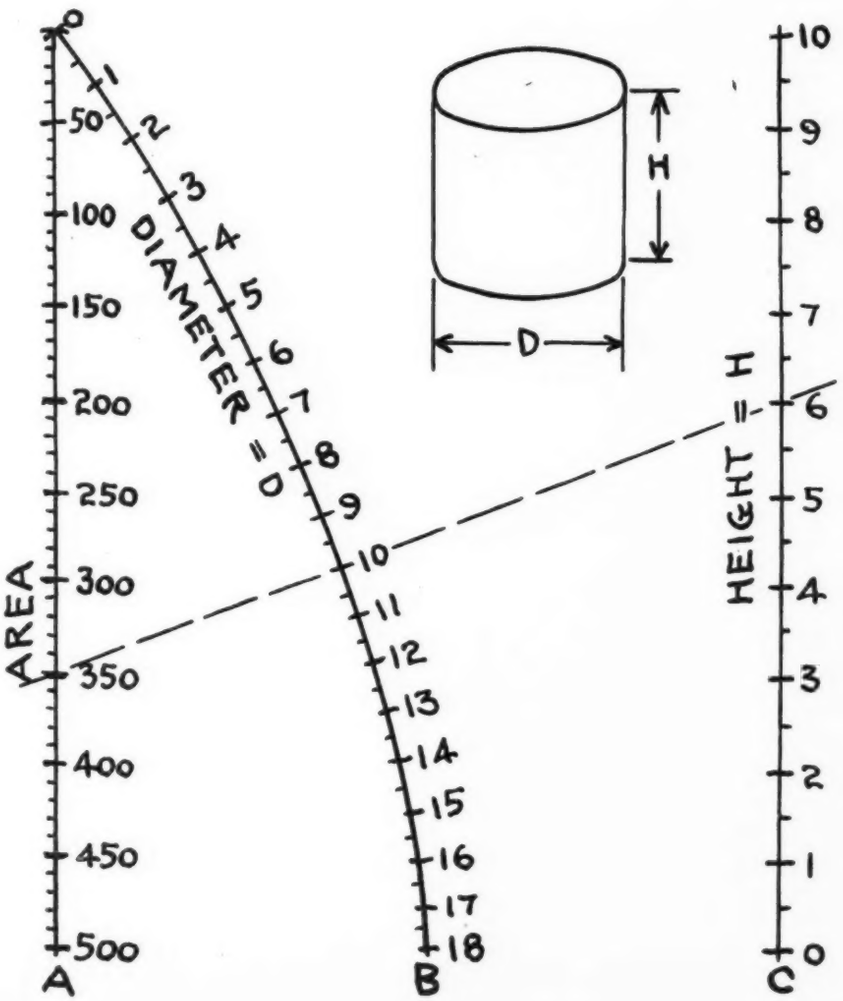
An interesting application of this tube is in the turbidimetry of quite clear waters through which the fine scratch stands out visibly through the full length column. In order to obtain a reading in such cases the water sample must be first artificially soiled a definite amount, i.e., sufficient to reduce the visibility level to a value within the range of the scale. From the turbidity reading so obtained is subtracted the amount intentionally added in order to determine the turbidity of the sample. This scheme permits turbidity determinations down to a few tenths of a part per million. A convenient method of soiling is to add 25 cc. of turbifacient, having a turbidity betwen 100 to 400 p.p.m., to a 2 liter water sample. River water which has been allowed to settle makes an excellent turbifacient. Turbidity of the test portion due to turbifacient may be allowed for by carrying out a parallel determination with soiled distilled water as the control. To facilitate quick use of this extrapolation device, several turbifacients may be used with turbidity-free water and appearance-level readings plotted as a curve showing artificial turbidity increment versus turbidity of the turbifacient. Reference to this curve will give the correction term for further tests.

A black stopper as a target at the bottom is necessitated to make the optical conditions for vision as poor as possible. Unless light absorption by the target is a maximum and color contrast kept at a minimum the scratches will be visible through a full length water column in the turbidity range of poorly filtered waters and in this way require addition of turbifacient where otherwise avoidable.

Uniformity in lighting is desirable for the proper use of this instrument, and enclosure within a suitable illuminated box will allow determinations under constant conditions at all times.

(Since this paper was prepared, Mr. Hirsch has become connected with the Louisiana Department of Education, at Baton Rouge, La., as Instructor in Water Purification, in connection with the sectional vocational short school program of the Department.)

Area of Cylindrical Objects



IT IS frequently desirable and necessary to compute the area of cylindrically-shaped objects, tanks, pipes, stacks, etc.

Here is a chart that instantly gives the total area of any cylinder of any ordinary height and any ordinary diameter. The chart automatically adds the two flat ends and the cylindrical surface without any "long hand" figuring whatever.

For example, if the diameter of the cylinder is 10 feet and the height 6 feet, how many square feet of metal will be required in its fabrication. Or how much surface is there to be painted, etc.

The dotted line drawn across the chart shows how easily it is done. The line passes through the 10, in the curved column B, and through the 6, in column C. The intersection with column A shows that the area is 350 sq. ft.

Of course any unit of measurement may be used. Thus if the diameter and height are in inches the area will be in square inches.

*From W. F. Schaphorst, M.E., Newark, N. J.

BOSTON'S NEW CONDUIT

Will be America's Premier of Steel-Concrete Pipe Lines

BELIEVED to be the largest and strongest pipe of its kind ever built, the accompanying illustration shows a length of steel-concrete pipe being fabricated for Boston's Metropolitan Water District's new 14½-mile pressure aqueduct, which will deliver 300 mgd. direct from the Wachusett Reservoir to the distribution system at a point close into the center of the city.

The pipe is of "Lock Joint" construction consisting of electric welded steel cylinders surrounded by reinforcing spirals of steel. The completed pipe is enveloped in a protective jacket and a lining of concrete. The latter provides the desired rigidity, added strength, longevity, and sustained capacity throughout its life expectancy of 75 years and, assumedly, an indefinite period beyond. The design of the steel cylinder is in itself based on requirements of a steel conduit for the service and conditions involved (pressure, water-hammer, etc.) but the economy lies in the lesser wall thickness and diameter which the protective concrete envelope, to eliminate corrosion and tuberculation, makes permissive.

Two sizes of pipe are being fabricated for this important arterial conduit. One is of 12′6″ diameter by 12′ long; the other size is of 11′6″ diameter and 16′ long. The longer pipes weigh 50 tons each and are being produced at the rate of 20 to 32 lengths per day. The steel contained in the 16′ pipes weighs 10 tons in itself—an interesting ratio of 4 concrete to 1 steel.

One of Boston's 50-Ton Steel-Concrete Pipes Under Fabrication

In the steel fabrication (all done at a central plant on the line of the conduit), the flat steel plates are first tack-welded together and then seam-welded with automatically controlled welding heads and operations—the current being supplied through 500 amp. "G.E." transformer-type welding sets. The welded plates are then rolled into cylindrical form and the closure seam is manually welded. The picture here shows the operation of spot-welding the reinforcing steel-spiral in place on the cylinder, revolved on a mandrel. For the latter operation each welder is supplied from an individual "G.E." 200 amp. motor generator unit, of which there are 40 in all. Some of these units may be employed for main or service pipe thawing during the winter should emergency justify such use.

The pipes are jointed with the patented tongue and groove type "Lock Joint," lead caulked in the trench from the inside. The contractor is The American Concrete and Steel Pipe Co.; the actual fabrication being done by The Lock Joint Pipe Co. of Ampere, N. J.

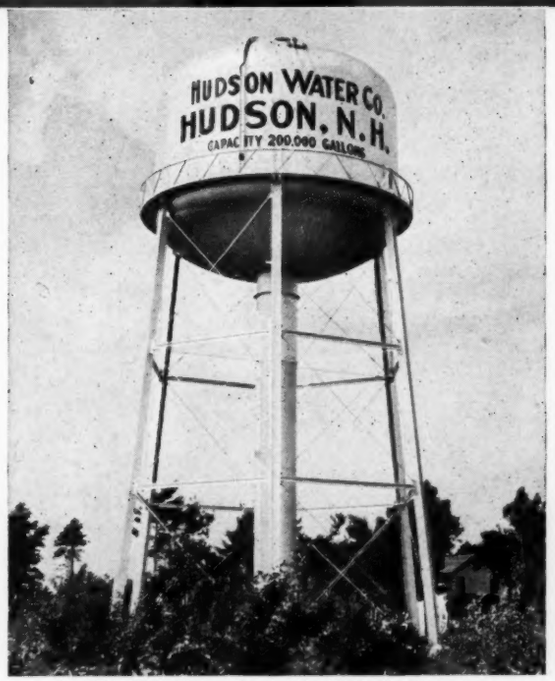
INFANTILE PARALYSIS VIRUS FOUND IN SEWAGE

The virus of poliomyelitis (infantile paralysis) has been extracted from samples of raw sewage and has been inoculated into monkeys with production of typical effects of this disease.

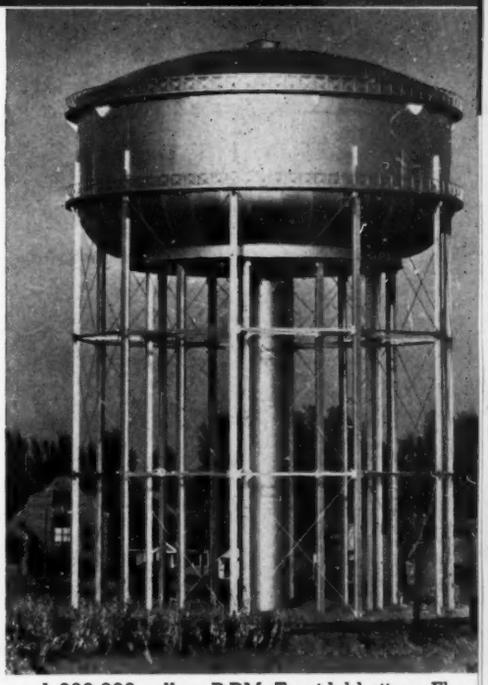
The discovery was anounced by Dr. John R. Paul and Dr. James D. Trask of Yale University, in a paper presented at the Society of American Bacteriologists Meeting on Dec. 30, 1939.

You are now LOOKING at THREE OF THE LATEST P·DM ELEVATED TANKS FOR MUNICIPAL WATER STORAGE

P·DM Double-Ellipsoidal All-Welded Elevated Steel Tank, 100,000-gallon capacity, installed for the Town of New Haven, Michigan



P·DM 200,000-gallon All-Welded Elevated Steel Tank, Double-Ellipsoidal Type, built for the Town of Hudson, New Hampshire



1,000,000-gallon P·DM Toroidal-bottom Elevated Steel Tank recently installed for the Municipality of Mason City, Iowa

Presenting an enduring picture of strength and dependability, these handsome Elevated Tanks by Pittsburgh-Des Moines are current examples of the most efficient method of improving service and cutting costs in the water supply of communities everywhere.

Elevated water storage in a properly balanced system affords the natural and logical means of supply, keeping pressures constant and pumping costs down. *This means that the ratepayer is better served, and the taxpayer better pleased!*

And when the municipality's investment is placed in Tanks by P·DM, the dividends in service and economy extend over a period of many years—long after rock-bottom first costs have been forgotten. P·DM, as master builders of Elevated Tanks from 50,000 to 5,000,000 gallons capacity, have the knowledge and experience, the equipment and fabricating skill, plus the advantage of *two* strategically-located plants, *to serve you best at lowest cost*. Wouldn't you like to have the details?

Call in a skilled P·DM Engineer—there's no obligation—and meantime, ask for our 20-page Modern Water Storage bulletin!

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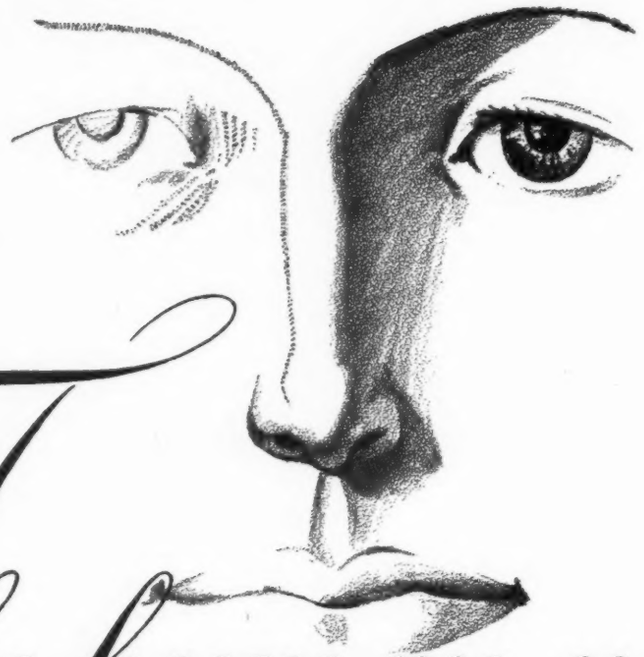
NEW YORK, ROOM 918-99, 270 BROADWAY . . CHICAGO, 1222 FIRST NATIONAL BANK BUILDING



The human nose

. . . DETECTS UNBELIEVABLY FAINT ODORS

CONTRARY to popular thought, the sense of taste is inferior to the sense of smell. If we could not smell the savory odors, most of our food would be relatively tasteless.

In the same manner, a very minute amount of an odorous substance can make the whole water supply of a city unpalatable. Virtually every city in the country is bothered at some time during the year with unpalatable tastes and odors caused by troublesome algae in the water.

AQUA NUCHAR Activated Carbon which, like a magnet, adsorbs tastes and odors, makes the water sparkling, sweet and palatable. 1100 cities throughout the country are now using AQUA NUCHAR Activated Carbon to keep the water supply palatable and their taxpayers happy.

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DIVISION WEST VIRGINIA PULP AND PAPER COMPANY

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NUCHAR → **AQUA NUCHAR**

An installation of 24-inch cast iron pipe for a sewer force main at Muskegon, Mich.

A 36-inch cast iron, infiltration-proof influent line for sewage treatment plant in District of Columbia.

Look for the "Q-Check" registered trade mark. Ca iron pipe is made in diameters from 1¼ to 84 inche

In the last ten years this country has matched in sewage works construction the progress of the previous 50 years. Sound planning for permanency is indicated by the sharp upward trend in the use of impermeable, rugged cast iron pipe, not only in treatment plants but for infiltration-proof sanitary mains. It is the modern material for sewerage systems.

THE CAST IRON PIPE RESEARCH ASSOCIATION, THOMAS F. WOLFE, RESEARCH ENGINEER, 1015 PEOPLES GAS BUILDING, CHICAGO, ILLINOIS

They Started Something!

UP TO 1793, when Eli Whitney invented the cotton gin, the cotton industry had always been hampered by the costly, time-consuming hand method of separating the seeds from the fibres.

Whitney's gin did the job in a fraction of the time required by hand—and at a fraction of the cost! The effect was tremendous. Cotton became one of the world's greatest industries. People in every walk of life were literally reclothed. It was the beginning of the high speed, large scale methods that distinguish production of cotton fabrics today. Seldom has a single invention had such a profound and far-reaching effect upon history. Eli Whitney *started something.*

The first cylinder of Liquid Chlorine made by EBG in 1909.

EBG engineers started something, too, when they built the first equipment in the U. S. A. for producing Liquid Chlorine. They made this valuable product available commercially in this country for the first time in 1909. They made it possible for people everywhere to be sure of pure water supplies . . . to protect themselves from diseases that lie in sewage. They doubled and tripled the efficiency of bleaching textiles, paper and other products. They started an industry that is both vital and far-reaching in its effects. EBG has the advantage of pioneer experience in producing and servicing Liquid Chlorine. That advantage will work to *your* advantage if you use EBG Liquid Chlorine.

EBG Liquid Chlorine

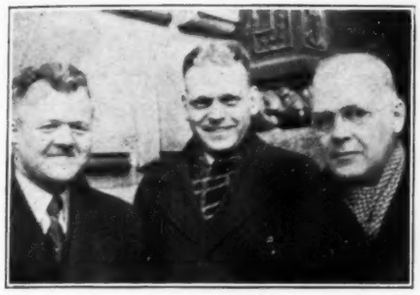
FIRST IN THE COUNTRY

ELECTRO BLEACHING GAS COMPANY
Main Office: 60 East 42nd Street, New York, N Y
Plant: Niagara Falls, N. Y.

NEW YORK SEWAGE WORKS ASSOCIATION

Features Raritan Basin Clean-Up and Visits Representative Plants

REPEATING the 1939 record with an official registration which slightly exceeded the 300 mark*, the 12th Annual Meeting of the N. Y. State Sewage Works Association on January 19th, and an all-day tour of inspection of New Jersey sewage plants on Saturday the 20th, brought to a close a busy week of meetings and activities of interest to sanitary engineers and water and sewage works operators in New York City.



Three Good Heads

C. George Andersen
Rockville Center, L. I.
(The New President)

Newell L. Nussbaumer
Buffalo, N. Y.
(Retiring President)

Arthur S. Bedell
Albany, N. Y.
(Secy.-Treas.)

On Wednesday and Thursday of the week were held the two sessions of the Sanitary Engineering Division of the American Society of Civil Engineers. Also on Thursday was held an important meeting of the Board of Control of the Federation of Sewage Works Associations, where the matter of the possible formation of a strong national sewage works association was considered and discussed. The basis of such discussion was the report rendered by a Special Committee on Expansion and Reorganization, which is to be found later in this report.

On Friday evening was held the Annual Joint Dinner of the Sanitary Engineering Division of A.S.C.E. and the N. Y. Sewage Works Association. The guest speaker was Col. John P. Hogan, President of A.S.C.E., after which an evening of entertainment followed.

* Estimated attendance 350 or better.

All Day Inspection Trip

On Friday the Association featured a paper relating the noteworthy progress made in a systematic program of reducing stream pollution in the Raritan River Basin by the New Jersey State Department of Health. In this program the Raritan drainage

New Directors

Robt. C. Wheeler
Consulting Engr.,
Albany, N. Y.

Joseph E. Rehler
Sup't. Water and
Sewerage,
Olean, N. Y.

basin has been considered as a unit, for the purpose of demonstrating what can be accomplished in establishing minimum standards for effluents from the several municipalities and industries in the basin, such being based on actual requirements when considering the various uses of the waters of the main river and its tributaries, and the full power of the receiving waters to assimilate pollution loads. In brief, the program has taken into account an equitable allocation of responsibility and requirements as to degree of purification demanded of pollution contributors. On Saturday members and guests were taken by buses on an all-day trip to representative treatment plants in the Raritan Basin, which provide primary treatment and chlorination the year 'round and supplemented by chemical precipitation during whatever period of the year such auxiliary treatment is required. Plants visited were those of New Brunswick, Middlesex and South River. In the basin there are 16 new or revamped treatment plants now in operation; 19 plants providing industrial waste treatment and 11 more under construction.

Awards and Prizes

The two Kenneth Allen Memorial Awards—one to that member contributing the most outstanding paper of an engineering or research nature during the year, and another to a plant operator contributing the most meritorious paper on an operating topic—were not awarded this year for reasons cited below.

In presenting the report of the Committee on Awards, Linn H. Enslow, Chairman, said that the committee regretted that no paper of an engineering or research nature, presented before the Association during the year, seemed to meet the rather stiff specifications which such papers had to meet in order to merit the Kenneth Allen Award. In respect to the award for the most meritorious paper of an operating nature, only one had met the specifications—that by Wellington Donaldson on "The First Year's Operation of the Ward's Island Treatment Plant of New York City," which was read before the Association January, 1939, and published in the January, 1939, issue of

Chas. A. Emerson—Chairman, Federation of Sewage Wk's. Associations, reviewing the report of the Special Committee on Expansion and Reorganization.
(On his right, President Nussbaumer; on his left, L. L. Luther, who received special recognition for his leadership in the Long Island Section.)

Sewage Works Journal. However, after selecting Mr. Donaldson's paper it was learned that the author had received the award in 1936. Under existing stipulations against repeat awards, Mr. Donaldson would not receive the award. In consequence, the citation was presented without the award.

The committee advocated a needed revision of the overly exacting Kenneth Allen Award specifications, and also a system of awarding chevrons to those who have previously won the award, for attaching to the handsome memorial wall plaque already possessed by the recipient.

Reporting for the Committee on Gadgets, R. C. Sweeney, Chairman, announced the following gadgeteers of the year, the contest having been held at the Fall Meeting in Olean, N. Y.

1st Prize to H. O. Johnson, Sup't, Belgrave Sewer District, Great Neck, L. I., for a chlorine pressure-drop alarm developed at his plant.

2nd Prize to J. E. Rehler, Sup't of Water and Sewage, Olean, N. Y., for his artificial light cabinet, involving adaptation of the new daylight fluorescent tube. The cabinet is used in making colorimetric plant tests.

Business Sessions

In the Report of the Secretary, Arthur S. Bedell revealed a new member gain during the year of 112, offset by a loss of 42 due to deaths and resignations. The net gain of 70 members raised the total membership at the year end to 669, of which 644 were active and 25 associate members. In analyzing the active membership, 30% (209) fall in the classification of plant superintendents, managers and operators.

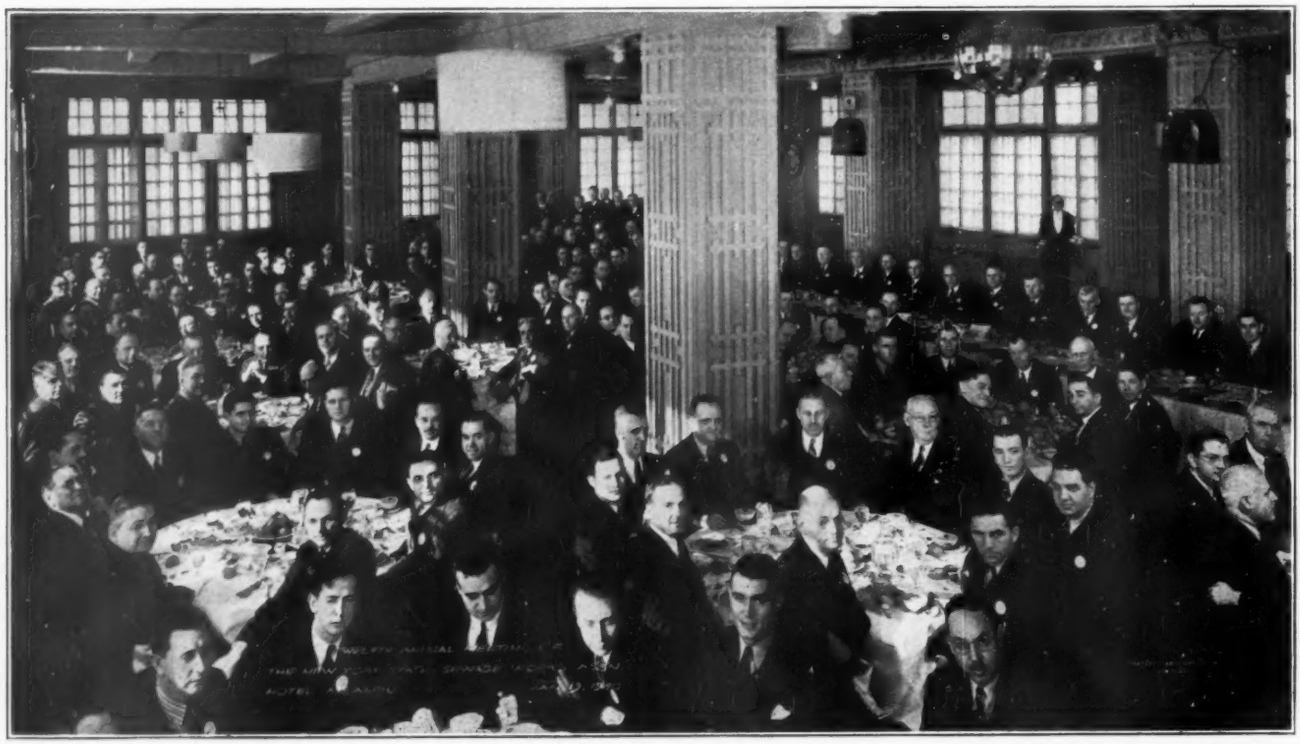
Secretary Bedell pointed out that the real strength of the association lay in its four regional sections, which hold interim meetings between those of the parent association. As the result of the success of the first to be established—the Long Island Section—others had been established to serve areas contiguous to Buffalo, Rochester and Albany, and known as the Western, The Gennessee Valley and Capital District Sections.

For the Committee on Short Schools, Fred J. Biele, Chairman, reported that four schools had been held during the year for Grade 3 operators, at which 447 registered and 75 attended without registration. During 1940 between April and September four schools will be held for Grade 2 operators. Mr. Biele remarked that the attendance at these schools had been larger than anticipated and had overtaxed facilities.

From the N. J. Dep't. of Health

Leroy Forman, Engr.-Chemist, and R. P. Johns, Ass't. Chemist. (Came to tell of accomplishments in the noteworthy "clean-up" in the Raritan River Basin.)

A resolution on Federal stream pollution legislation, which failed of passage on its first presentation because of its rather drastic phraseology, was redrawn, presented and passed. In essence the resolution reiterates previously expressed views by the Association concerning the types of proposed Federal anti-pollution legislation and the agencies involved in the several pending bills. The Association now again goes on record in expressing a dislike for any anti-pollution legislation, at present being considered, that will place such act under a Federal agency other than the U. S. Public Health Service. The resolution points out that the latter agency already has the properly qualified personnel and the benefits of long experience in stream pollution problems, which considerations are all important toward efficient, considerate and overall effective handling of anti-pollution measures. Further, that the Public Health Service is geared to work in harmony with state health departments and other agencies of the individual states; that the latter could benefit from coordination of efforts and effective guidance by the Federal health agency to produce the most harmonious and least costly national program of pollution abatement.



The Luncheon Session, attended by 238 Members and Guests—Many of the latter being from points as far distant as the Pacific Coast, to lend a national complexion to the meeting. One distinguished guest, H. A. Van Norman, Gen'l. Mgr., Dep't. of Water and Power, Los Angeles; Prof. Chas. Gilman Hyde, Univ. of California, another.

New Officers

The following officers were elected:

President
C. George Andersen
Sup't of Sewerage
Rockville Center, L. I.

Vice-President
H. H. Wagenhals
N. Y. Dep't of Health
Syracuse, N. Y.

Sec'y-Treas.
Arthur S. Bedell
N. Y. Dep't of Health
Albany, N. Y.

Ass't Sec'y-Treas.
J. C. Brigham
N. Y. Dep't of Health
Albany, N. Y.

The following were elected members of the Executive Committee to serve 3-year terms:

Prof. Lewis V. Carpenter,* N. Y. University, New York City.

Joseph E. Rehler, Sup't, Water and Sewerage, Olean, N. Y.

Robert C. Wheeler, Cons. Engineer, Albany, N. Y.

A National Sewage Works Association?

Last year at its annual meeting the Board of Control of the Federation of Sewage Works Associations discussed the possibilities of setting up a more closely knit organization than the present Federation of numerous regional associations represents. To investigate the question of need and merit of a strong National sewage works association a special committee was appointed, with C. A. Emerson, Chairman of the Board, as Chairman of the new Committee on Expansion and Reorganization. This committee presented its first report to the Board of Control at its annual meeting on January 18th. After considerable discussion and minor alterations the report was approved by the Board for publication and discussion by the various member associations in the Federation before further action is to be taken. In the meantime, the committee is to proceed with its investigations and study.

The first report, presented by Chairman Emerson during the Luncheon Session of the New York Association, follows:

Progress Report Committee for Expansion and Reorganization

"The Committee appointed to consider methods whereby the Federation of Sewage Works Associations can more adequately serve all branches of the field has had several group meetings and one general meeting. In addition, there has been much interchange of views by correspondence.

Wm. J. Key, Sup't. Sewage Treatment, Middlesex, N. J.
(Had a neat plant to show off)

L. P. Booz, Consulting Engr., Perth Amboy, N. J.
(Designer of three Raritan Basin Plants.)

"While the accomplishments of the Federation have been noteworthy and have materially exceeded the expectations of those present at its organization more than a decade ago, the Committee is of the opinion that its activities must be broadened if it is to continue as the recognized national representative association in this rapidly growing field. It is believed that to exert such increased influence there must be closer cooperation of the various member associations and some kind of central organi-

Committeemen
Ralph Sweeney, Albany
(Who handles the Gadget Contests)
"Bill" Raisch, N. Y. City
(Who has long handled local arrangements.)

zation to co-ordinate activities and assume the increased responsibilities of management which will necessarily attend such activity.

The Committee believes that the merging of the scientific activities or executive management of the present Federation with those of any other organization now existent would be detrimental to the best interests of all concerned.

The Committee has found that there is a definite demand in certain quarters for a national sewerage association to serve the entire field of sewerage and sewage treatment; provide a national convention where there could be an interchange of views by representatives from the entire country, and furnish opportunity for manufacturers of equipment to exhibit their products to full advantage.

It has been suggested that such an association be formed and patterned along the general lines of the American Water Works Association. However, the Committee is definitely of the opinion that launching of such a national association would be a serious error and is not at all necessary as it will be possible to modify and extend the activities of the Federation to adequately meet the needs of all branches of the field. The prestige attained by the Federation during its eleven years of independent existence and the power and influence which can be exerted by its 3,000 members in this country and abroad must be recognized and protected.

Manifestly, such an expansion will require changes in the present organization and necessitate provision of funds to finance a central office to further committee work, and to care for many other necessary expenses.

It is clear that the growing interest of manufacturers of equipment must be given recognition and it is believed that through such recognition, together with increase in frequency of publication of SEWAGE WORKS JOURNAL, which will increase its value as an advertising medium, necessary funds may be made available for such definite increase in the value and prestige of the organization. However, it is not felt that such greater worth and influence can be attained without more liberal support from the individuals composing the various member associations.

Funds are now being sought whereby some such activities can be underwritten as a definite start toward expansion. Admittedly, no disruptive change, far-reaching reorganization, or displacement of the Federation should be attempted, but it should be recognized that changes are demanded and there should be wholehearted, earnest endeavor to constantly push forward to the end that is sought, keeping the Federation always in a position to meet the changing needs of the growing field of sewerage and sewage treatment.

The Committee feels that changes in the Constitution and By-Laws of the Federation should be made to eliminate features which work to limit the activities of the organization to those of the member associations, and which prevent the formation of a central organization needed to coordinate and expand activities. Such changes cannot be made at this annual meeting, but it is recommended

*Prevented by illness from attending the meeting, a resolution of sympathy and hopes for speedy recovery went to Prof. Carpenter from fellow members.

(1) *Jas. R. Losee, City Engr., Tarrytown, N. Y. and Jas. K. Giesey, of Greeley and Hansen, Engrs., Kenmore, N. Y.*
(2) *W. Fred Welsch, Chief Engr., Nassau Co. Dep't. of Public Wk's., Hempstead, L. I., and Don Andrews, City Engr., Salamanca, N. Y.*
(3) *"Bill" Highberger, Mathieson Alkali Wk's., and the first and only "memberess" of the association, Mona Cordell, from New York's Ward's Island Laboratory.*
(4) *A. G. Martin, Commissioner of Sewers, Kenmore, N. Y. (Chairman of the Western Section) and Channel Samson, Sup't. Sewerage, Kenmore, N. Y. (member of Executive Committee.)*
(5) *George Lewers, Engr., Underpinning and Foundation Co. and Chas. Kirsner, Chief Operator, Cedarhurst, L. I.*

that an active committee be put to work to formulate such changes and report to the Executive Committee within ninety days, and after approval of that committee that such revisions be placed before a special meeting of the Board of Control. Attached are certain suggestions for changes* which are submitted for consideration of such a committee."

[The numerous suggested changes in the Constitution and By-Laws are too lengthy for incorporation in this report.—ED.]

Technical Sessions

[President N. L. NUSSBAUMER Presiding]

"Regulation of Stream Pollution in the Raritan River Basin"—by LEROY FORMAN, Sanitary Engr. and Chemist, and R. P. JOHNS, Ass't Chemist, N. J. State Dep't of Health, Trenton, N. J.

Messrs. Forman and Johns paper proved an interesting review of the history of the Raritan Valley "clean-up", which constitutes as an outstanding example of what may be accomplished under State Health Department regulations in securing equitable and comprehensive pollution abatement throughout a complete drainage basin considered as a unit, and dealt with accordingly, from its potable headwaters to its heavily industrially polluted tidal stretches.

Delayed during the early depression years, due to lack of funds by municipalities, the availability of Federal aid through P.W.A. made possible the speedy enforcement of orders issued on every municipality in the Raritan Basin, the program having to date involved construction of new treatment plants by 11 municipalities and major improvements to existing plants of 2 municipalities. Of the 11 new plants, 8 involve chemical precipitation, following the lead and demonstration of the practicability and effectiveness of the method at the Perth Amboy plant. In a survey check-up on attainments and operating efficiency of the 11 new plants the reduction in pounds of oxygen demand effected has averaged 53.2%; and that by the 2 revamped plants (secondary treatment) 71%, the net result being the appearance of fish in the lower river for the first time in 20 years.

Concerning industrial pollution, now being tackled, a count had revealed 193 industries in the basin, 37 of which discharge wastes to the streams direct and many others to city sewers, the latter act legally transferring responsibility to the municipality for proper treatment of the combined sewage. In a survey of the 37 polluting industries, flow measurements and analyses indicates 38 m.g.d. of wastes equivalent in population loading (B.O.D. basis) to 439,000 people. To date 19 industries have treatment plants operating, 11 have plants under construction, 4 are making required studies of methods, leaving 2 under notice.

As to the effluent standards, the following requirements have been fixed for the Raritan Basin, which should be realized for all effluents during the present year.

(1) No free acid, alkali or poisonous chemicals.
(2) No grease, oil or other floating matters.
(3) No objectionable odor.
(4) Color not in excess of that neutralized by the stream.
(5) B.Coli—
(a) 1 per cc. in not more than 1 sample in 4.
(b) 10 per cc. in not more than 1 sample in 16.
(6) B.O.D.—not more than that which the stream can assimilate without depleting its oxygen balance to less than 50% of saturation.

DR. WILLEM RUDOLFS, Director Water and Sewage Research, N. J. Exptl. Station, complimented the State Department of Health on attainments in the Raritan Basin, as an effective demonstration of what may be accomplished when taking a stream as a whole and according equitable treatment to all polluters alike. Particularly significant was the follow-up in the way of industrial waste corrections, in order that the $4,000,000 spent by municipalities for pollution abatement might count for something more than mere compliance with an order issued by the State agency.

"Improving Sewage Clarification by Pre-flocculation Without the Aid of Chemicals"—by A. J. FISCHER and A. HILLMAN, The

(1) *Dr. W. Rudolfs, Agr. Expt'l. Sta., and Asher Atkinson, Engr. Water Dep't., New Brunswick, N. J.*
(2) *Chief Fuller, Middlesex, N. J. Police and Wm. H. Withington, The Hardinge Co., York, Pa.*
(3) *"Hank" Hotchkiss, Jr., Chemist, Water and Sewage Dep't., Larchmont, N. Y., and Leonard Langford, Engr., Pacific Flush Tank Co., N. Y. City*
(4) *A. H. Stevenson, with Malcolm Pirnie, Engr., N. Y. City, and Ralph E. Furhman, Sup't., D. C. Treatment Works, Washington, D. C.*
(5) *"Steve" Kowalchick, Ass't. Engr., N. J. Dep't. of Health, Trenton, and "Doc" George E. Symons, Chief Chemist, Buffalo Sewer Authority.*

Views on the Trip of Inspection

(1) The attractive little plant of Middlesex, N. J. (2) One of the twin sludge filters at New Brunswick. (3) The compact and efficient chemical treatment plant of South River, N. J. A view of one of the twin clarifiers equipped with down-flow self-cleansing sand strainers—note the dirty wash water return to the inlet chamber at center. (4) And, a specimen of South River effluent is proudly exhibited by A. B. Kozman, as evidence of the worth of effluent filters in chemical precipitation plants—(No, he didn't drink any of it.) (This strip of photographs was taken by Nelson Fuller of Olean, N. Y.)

Dorr Company, Inc., New York City.

In this paper, presented by Dr. Fischer, the effectiveness of mechanical flocculation of sewages without the addition of coagulants was revealed to be a decided aid in solids and oxygen demand removal in clarifiers. The results from studies and observations at Cedar Rapids, Ia., and at Ypsilanti, Mich., were reviewed — the latter plant being equipped with the Dorr "Clari-Flocculator", which is a circular clarifier with an enlarged center influent well equipped with the floc forming mechanism, the largest such unit of the 12 sold to date being that of 100 ft. diameter at Bakersfield, Calif. Results of studies on raw sewages indicated 9.6% to 15% improvement in B.O.D. reductions at Ypsilanti with a 15-minute floccing period followed by a 45-minute sedimentation period. Or, expressed in another way, 35% more flow could be handled with equal results; or, at equal flows a 23% increase in solids removal resulted. Dr. Fischer also pointed out the efficacy of the device in connection with clarification of trickling filter effluents.

In the summary and conclusions it was pointed out that:

(1) Laboratory test results with mechanical flocculation can be duplicated in plant practice, provided that samples are not held over a period of hours during which self flocculation frequently results and the suspended solids test becomes misleading.

(2) For raw sewage; 30 to 40 minutes of flocculation, followed by 1.5 to 2 hours of settling and maximum clarifier overflow rate of 800 gals./sq. ft./day—all based on average design flows—is recommended.

(3) For trickling filter effluents; 30 minutes of flocculation followed by 1 hour of settling and average overflow rate of 1000 gals./sq.ft./day should be satisfactory.

(4) The scheme possesses merits on the score of increased clarifier capacities or increased clarification efficiencies, the attractiveness of the method being demonstrated by its rapid acceptance—20 plants having been flocculator equipped during the past 3 years.

H. W. Gehm, Research Chemist, N. J. Experimental Station, is commenting on such left-induced flocculation, pointed out that the nature of the sewage seemingly had a considerable bearing on the degree of flocculation attainable,—for instance hard water sewages being more amenable than soft water sewages. However, the scheme had the decided advantage over the use of chemicals in operating costs and expenditure per unit of B.O.D. and solids removal.

C. R. Velzy, Sup't., Buffalo Treatment Works, Mona Cordell, Ass't. Chemist, Wards Island (N. Y.) Plant. (Who won't agree that the sewage works laboratory has its points?) Stanley Barker, Engr., N. Y. State Dep't. of Health.

"Studies in Corrosion Resistance of Metals in Sewage Treatment Plants"—by G. L. Cox, Research and Development Division, International Nickel Co., Inc., New York City.

Mr. Cox's paper recounted observations of the resistance of a variety of metals and alloys to attack by sludge, sewage, digester gas and chemicals in sewage treatment, with particular reference to alloys of nickel-copper (Monel) and nickel-iron (Ni-Resist). He cited the incompleted studies under way at the sewage plant of Newark, N. Y., where corrosion had been severe due to the high content of hydrogen sulphide (100 to 300 grains/100 cu. ft.) in the digester gas. Because of their erratic nature, results from the initial series had been inconclusive. Mr. Cox then described the equipment set-up and the program now under way in a new series of tests. [It is apparent that when the Program Committee scheduled this paper the failure of the initial series was wholly unlooked for.—Ed.]

R. S. Burr, American Brass Co., Waterbury, Conn., in discussion, pointed out that the logical corrective for gas corrosion was that of gas scrubbing to reduce or eliminate the only important corrosion producing element contained — namely, the hydrogen sulphide.

In reporting on plant scale tests covering a 2-year period of exposure of red-brass, pure copper tubing, Admiralty metal, and tinned copper tubing, to sludge gas, it had been observed that copper tubing scaled and pitted while red-brass was less attacked. Admiralty metal, proving the best performer, was hardly attacked at all beyond its blackened color. Based on this observation, and experience in the oil refining field, tubes in heat-recovery units (exchangers) should be of Admiralty metal.

For heating coils in digesters, Mr. Burr reported that satisfactory results had been had with tin-coated copper tubing, employed because of its high heat transfer properties, whereas the use of bare copper tubing would seem questionable except as a conduit to and from the digesters to connect with the tinned tubing. Outside of digesters copper tubing, because of its resistance, workability and trim, had been advancing in use at sewage plants.

"Problems and Progress in the Chlorination of Sewage"—by A. E. Griffin, Chemist, Wallace and Tiernan Co., Newark, N. J.

(1) *The neat chemical and vacuum filter room at South River. (Here luncheon was served.)* (2) *Thos. M. Riddick, Consulting Engr. and Chemist, N. Y. City, and Frank C. Roe, Mgr., Sanitary Sales, The Carborundum Co., Niagara Falls.* (3) *One of the ingenious travelling sand-filter washing mechanisms at South River.*

Mr. Griffin pointed out that chlorine dosage control at sewage plants necessitated taking into consideration the changing strength (chlorine demand) of the sewage with changing rates of flow. Unfortunately, as the flow mounted toward daily peaks the chlorine demand mounted at a much steeper rate of increase than the flow rate curve, to give a total demand maximum in pounds per day reaching ratios of 8 to 10 times the minimum. Based on flow changes above the ratio would be of the order of but 2 to 1. He cited studies at Buffalo, N. Y., and elsewhere to determine a dosage schedule, programmed on the basis of changing hourly demands. Based on such program, manual adjustments of feed rates to maintain effective chlorination, at the same time reducing periods of wasteful over-chlorination to the practicable minimum. A chlorine demand graph at one plant revealed that as many as 6 changes daily in the manual chlorinator settings would not completely eliminate waste due to over-chlorination during intervals between such changes.

To provide exact sewage chlorination without waste in chlorine or time required for making frequent changes in chlorinator settings, and to take care of the "unusual," an almost human machine has been developed by Wallace and Tiernan Co. Such consists of a fully automatic chlorinator that measures the oxidation-reduction potential of the sewage and automatically adjusts the feed of chlorine to meet such changing potential. Mr. Griffin said that the Potential Chlorinator had demonstrated its practicability. A lantern slide of a representative 24-hour feed chart from such a machine effectively pictured what a wide range in hourly chlorine output was involved in maintaining effective chlorination at the least cost for chlorine. Also, the same machine could be set to produce partial chlorination to satisfy any desired part of the changing chlorine demand, such as would be desirable in partial chlorination up-sewer for odor control or reducing bacterial loading on streams and coastal bathing waters.

M. H. KLEGERMAN, Consulting Engineer (with Alexander Potter), New York City, presented several graphs made from plant data, which effectively pictured the hourly variations in total chlorine demand at 3 plants studied. In two instances (relatively small systems) the day's variation in the demand rate in lbs./24 hrs. was of the magnitude of 5 to 1. In the third (a larger system) the variation recorded was actually 8 to 1 in

"Nick" Miljevic, Chemist, Lackawanna, N. Y. (He's now a "Dollar a Year Man". Couldn't be fired so he works for the dollar a year.)
Nelson M. Fuller, San. Engr., Cattaraugus County, Olean, N. Y.
A. B. Kozma, Engr., Underpinning and Foundation Co., N. Y. City. (Proud of the South River job.)

respect to maximum and minimum hourly demand. Mr. Klegerman pointed out a number of factors which combine to influence the total chlorine demand, the more important being temperature, nature of water supply, sewer grades and length of sewer, and the presence of industrial wastes. Of these, the factors of most universal importance were temperature and the age of the sewage from its point of entry to the sewer and its arrival at the point of chlorine application, in other words the rate and the span of bacterial degradation, plus the extent of breaking up of solids by comminution or liquefaction—all of which is commonly referred to as septization.

Mr. Klegerman, remarking that the importance of chlorine in sewage treatment has approached that of cement in concrete production, laid emphasis on the worthwhile information made available to designing engineers and the sewerage fraternity by such agencies as The Chlorine Institute and Wallace and Tiernan's research and development department.

H. A. FABER, Research Chemist of The Chlorine Institute, in briefly presenting some of the newer adaptations of chlorine as an aid to improved sewage treatment, reviewed the developments to date with "aero-chlorination" for separating greases from sewage, and the effect of the procedure in decidedly improving plant performance where the activated sludge process is utilized. He emphasized the small dosages of chlorine involved (1 to 2 ppm.) and 2 to 5 minute aeration period, requiring 0.06 cu.ft. or thereabouts of air per gallon. Mr. Faber stated that the continued effectiveness of the process in bettering plant performance at Lancaster, Pa., in year 'round operation was gratifying. And, he pointed out that the largest plant to adopt the process is the Easterly Plant of Cleveland, Ohio. He also cited its effectiveness at a wool-scouring plant.

(In the new plant at Dallas, Texas, "aero-chlorination" is being incorporated as a combination odor control and grease separation scheme ahead of the settling units. The process is expected to preclude the greasing up of the revolving distributors, and stone beds of the trickling filters. In Dallas the grease problem is accentuated by packing-house wastes discharged to the sewers.—ED.)

Syracuse Selected for Next Meeting

The Spring Meeting of the Association is to be held in Syracuse, N. Y., on June 20, 21 and 22, 1940. It is at this meeting that the annual exhibit of sewerage materials and equipment is staged.

In Appreciation

The buses for the trip to the Raritan Valley plants were supplied through the courtesy of The Dorr Co., Inc., The Jeffrey Mfg. Co., the Pacific Flush Tank Co. and the Wallace and Tiernan Co., Inc. The luncheon served at the South River plant was furnished by the Underpinning and Foundation Co.

The local Committee on Arrangements consisted of Messrs. William Raisch, Consulting Engr., and William Sylvester of the New York Department of Public Works.

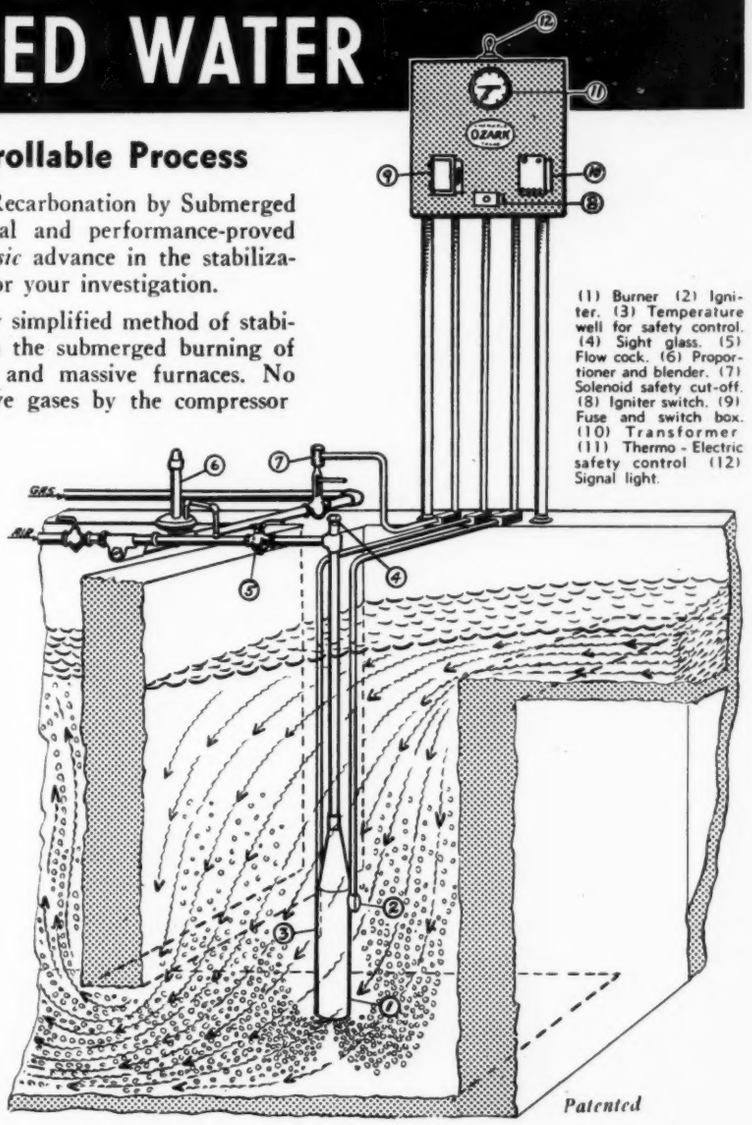
"The End of the N. J. Trail" brought the half-frozen survivors to the doors of W & T's plant in Belleville, N. J.

NEW WAY TO RECARBONATE LIME-SOFTENED WATER

by Less Costly, Simpler, Controllable Process

From an "interesting theoretical possibility," Recarbonation by Submerged Combustion has at last developed into a practical and performance-proved reality. And out of its development has come a *basic* advance in the stabilization of lime-softened water which definitely calls for your investigation.

The Submerged Combustion process is a vastly simplified method of stabilization in which recarbonation is effected through the submerged burning of gas from city mains. No cumbersome equipment and massive furnaces. No scrubbing of CO_2. No handling of moist, corrosive gases by the compressor No costly corrosion of expensive equipment.



(1) Burner (2) Igniter. (3) Temperature well for safety control. (4) Sight glass. (5) Flow cock. (6) Proportioner and blender. (7) Solenoid safety cut-off. (8) Igniter switch. (9) Fuse and switch box. (10) Transformer (11) Thermo - Electric safety control (12) Signal light.

Here, briefly, are the advantages of the new process—each fully proved in the severest tests of actual service:

1. Costly equipment and massive furnaces are replaced by simple, compact apparatus.
2. The installation cost will ordinarily be lower.
3. Operating cost is drastically reduced—running as low as 35c per million gallons at Oklahoma City, Oklahoma, including allowance for maintenance and amortization.
4. Automatic, trouble-free operation—definitely reducing labor costs.
5. No corrosion.
6. No diffusers.
7. New standard of chemical efficiency — utilizing 10% to 20% higher ratio of CO_2.
8. **No plant interruption to install. Apparatus is simply set in position, connected and started!**

Fuller Award Nominee

L. H. Scott
Sup't Filtration, Oklahoma City

Proved in Use at Oklahoma City

There is nothing experimental or uncertain about the equipment, procedure or results of the Submerged Combustion process. For 18 months—since August, 1938—the entire normal water supply of Oklahoma City (16 M.G.D.) has been successfully recarbonated by one 5-inch submerged burner, under the direction of L. H. Scott, Superintendent of Filtration, who co-operated with the Ozark Chemical Company in the perfection of the process. Of such fundamental importance is the development regarded by authorities that at the Southwest Section of the A. W. W. A., Mr. Scott was named candidate for the George W. Fuller Memorial Award on two citations, the first reading "The adaptation of underwater gas burning in developing the interesting scheme of recarbonation of water by simple and novel submerged combustion."

The Submerged Combustion Process is now presented as a thoroughly perfected and commercially practical method ot stabilizing lime-softened water through recarbonation. May we ask that you read again the list of advantages and then, if you are interested in how this new and improved method of recarbonation might be installed in your plant, send in the coupon. Complete information will be sent you without the slightest cost or obligation. Simply fill in and mail the coupon!

MAIL THIS COUPON

Complete information will be sent you without obligation.

Ozark Chemical Company
Box 449, Tulsa, Okla.

Please send me without obligation, complete information on the Submerged Combustion Process of Recarbonation.

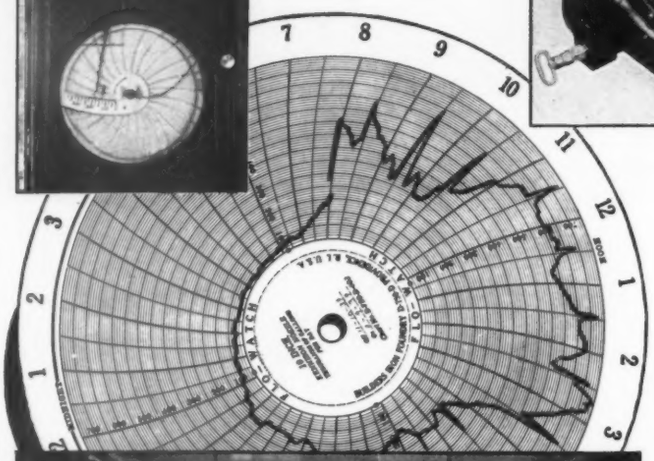
NAME .....

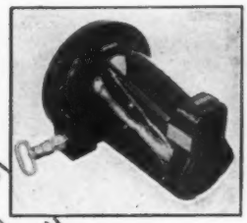
POSITION .....

ADDRESS .....

CITY ..... STATE .....

OZARK CHEMICAL COMPANY
Tulsa . . . . . Oklahoma





BUILDERS *Kennison Nozzle*

"entirely satisfactory . . . could not have made better selection"

so writes City Manager, R. A. Finlayson, Montrose, Colo.,* mentioning particularly the ease of installation which was made by their own men following directions furnished. The chart follows flow variations closely and indicates clearly the hourly automatic cleaning of the screen.

Kennison Nozzles (from 6″ to 36″ diameter) should be specified for measurement of raw sewage, sludge, and trade wastes carrying suspended solids. *Ask for Bulletin 308.*

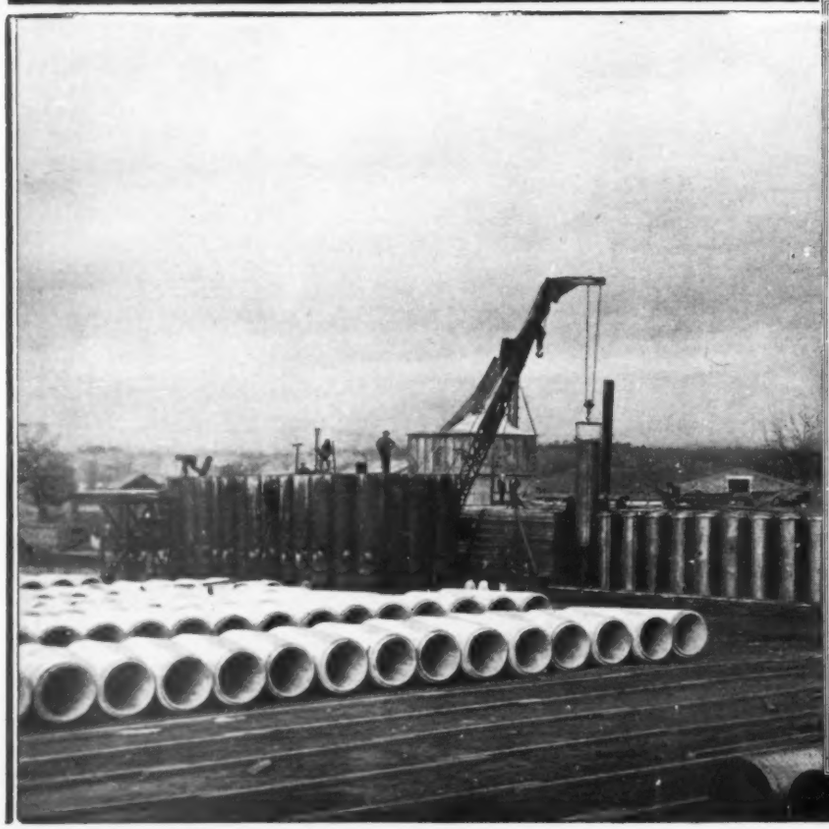
**Consulting Engineer, Burton Lowther, Denver, Colo.*

BUILDERS IRON FOUNDRY

"QUALITY, a tradition for over 100 years"

9 Codding Street **Providence, R. I.**

LOCK JOINT Rein-forced CONCRETE PRESSURE PIPE



Lock Joint Reinforced Concrete Water or Sewer Pipe made in your own town by Local Labor and using Local Materials will benefit Your Community to a far greater extent than the purchase of pipe shipped in from some distant city.

This is but one of the many reasons why progressive Engineers and City Officials choose Lock Joint Reinforced Concrete Pipe for their new Water or Sewer Projects.

Lock Joint Pipe Co. Ampere, N. J.
Est. 1905
Pressure Subaqueous Sewer Culvert

A. W. W. A. CONVENTIONS TO THOSE WHO ATTEND

IN A VERY interesting contest conceived and staged by Industrial Chemical Sales Division of West Virginia Pulp and Paper Co., through its little monthly *Taste and Odor Control Journal, readers were* invited to contribute statements of 250 words or less, telling of "What A.W.W.A. Conventions Have Meant to Me". For the three best papers in the minds of judges, all editors of technical magazines in the water supply field, worthwhile cash prizes were awarded.

Impressive was the number and quality of responses to this contest invitation. These came from men at the top, as well as those who have started their climb to better things in the water works profession.

It is to be noted that one of the very best of the contributions came from a past-president of A.W.W.A.

It proved difficult to choose between the papers receiving first and second awards, as readers of each will appreciate, but in the final voting the contribution of one of A.W.W.A.'s younger members was given first place.

The third winner, a young chemist who is superintendent of filtration in a city of medium size, has gained enough from A.W.W.A. meetings to become a leader in his local Section—probably because of his philosophy, that "Men, like water, must keep moving onward if they would avoid becoming stagnant and stale".

As one of the judges this writer was so impressed with the contest papers that permission has been secured to reproduce the three winning papers here. So many more were excellent that we wish space was available for their reproduction also. Possibly "nuggets" from some of these will later be printed en-composite. For the present, however, the winning papers are reproduced in the order of contest placement given by the judges.

"What Attendance at A.W.W.A. Meetings Has Meant to Me"

BY W. V. WEIR, SUPERINTENDENT

St. Louis County Water Company
University City, St. Louis, Mo.

Attendance at the Annual Meetings of the A.W.W.A. has meant two things to me—*Education and Incentive.*

The excellent periodicals and the A.W.W.A. Journal ably present the work being done in the water works field, but cannot give the whole story. Only by discussing, in and out of Convention meeting rooms, the work of these authors with the men themselves is it possible to correlate their findings with my problems.

The exhibits offer a quick education regarding developments in our field. While these are commercial exhibits, they are really brain children of men having problems similar to mine which they have solved with new equipment or processes practical enough to warrant offering to the water works field.

Each of us needs incentive if we are to produce and enjoy doing so. The annual mental proddings I receive at each Convention provide the stimulus to make fresh attacks on old problems. By hearing and discussing the other fellow's problems I become aware of similar problems which exist or will exist for me, and am challenged to solve them creditably. Fellowship with other men, as, or more capable than I, renews the challenge to accomplish more in this service industry; to strive to advance in my profession.

Education, incentive and Convention attendance will enable me to widen the gap between what I am paid and what my services are worth. I hope my pay never equals my worth. but I also hope Fortune doesn't allow the gap to become too wide.

By R. L. DOBBIN, MANAGER

Peterborough Utilities Commission
Peterborough, Canada

From a background of over twenty-five years of continuous attendance at the Annual Conventions of the Association, I have this to say:

FIRST: It has meant an acquaintance with the leaders of the profession which has strengthened me in my work at home.

SECOND: It has meant the rubbing of elbows with the rank and file of the members, those wholesome and efficient fellows who are doing the actual work in many thousands of waterworks plants, and the informal chats with them, resulting in that exchange of experience which is so valuable.

THIRD: It has meant the opportunity to contribute a paper or two and to take part in the discussions of other papers, thus doing my small part to help the other waterworks operator who may have similar problems.

FOURTH: It has meant visits to most of the larger cities of the Continent, and a consequent broadening of vision and appreciation of national and international problems.

FIFTH: It has meant the privilege of examining every year, an exhibit of the latest in waterworks equipment and supplies, and the contact with the finest group of salesmen on the continent.

SIXTH: It has meant to me especially, the friendship of a lot of grand neighbors, whose kindly interest and regard has helped so much.

FINALLY: It has meant so much to me that I trust I will never have to miss an Annual Convention.

BY A. R. TODD

Superintendent of Purification
Wheeling, W. Va.

Attending A.W.W.A. meetings always has given me a feeling of real inspiration because of the opportunities these gatherings afford to share in the thought of the best minds of our profession. From a practical standpoint, what could be more worthwhile than the self-improvement that comes through meeting such able and distinguished speakers as those who regularly grace our programs, and to be made acquainted, first-hand, with their seasoned judgment and experience?

Speaking personally, I have found our meetings an annual postgraduate course in the steadily advancing developments in the waterworks field. I feel that each one has added to my knowledge and made me more valuable to my employers. I have learned and profited through the manufacturers' displays and kept up-to-date on equipment and mechanical operations. I can conceive of no better way—certainly, no more convenient way—of keeping in step with the progress of our times and our work.

Meetings of the A.W.W.A. have still other advantages. Balancing the serious side are the social diversions. The entertainment program has never once failed to provide welcome relief from the cares and worries of laboratory and office. It would be a unique experience, indeed, to meet anyone attending our meetings who might say that he was not both rested and refreshed.

You'll never find a more congenial group, a more helpful and progressive lot of men, than the A.W.W.A. membership.

Yes, attending an A.W.W.A. meeting is well worth while, remembering, above all, that men like water, must keep moving onward if they would avoid becoming stagnant and stale.

And, How About You Mr. Reader?

These three statements are sufficient to indicate what attendance at meetings of water and sewage works associations can mean to those who have a desire to keep moving and thus avoid becoming stagnant. What such meetings can do for men with a will to find out can never be learned by remaining at home. Those who find it necessary to finance some part, if not all, of the cost of attending meetings are more than apt to be the ones to get the most out of them, and to find the investment pays.

A.W.W.A. BOARD SELECTS

Norman J. Howard

For President
NORMAN J. HOWARD

For Vice President
LOUIS R. HOWSON

Louis R. Howson

The Diven Medal Goes to W. Victor Weir
Goodell Prize to Thos. M. Wiggin and M. L. Enger

MEETING a full two days for the first time, A.W.W.A.'s Board of Directors found ample to occupy their attention for the best part of these two days, January 16th and 17th; choosing officers for the ensuing year; hearing, discussing and acting on committee reports; untangling a deadlock in the Committee on Hydrant Specifications which will now allow speedy publication of these specifications; reviewing and passing the 1940-41 budget; appraising the strides being made by the Association; and, at the close, reviewing the nearly completed technical program for the Kansas City Convention. All in all it was a busy and profitable two days that were put in by 31 of the 33 members of the Board.

Officers Chosen

As the first order of business the Directors from the several Sections met as a Nominating Committee to elevate Vice-President Norman J. Howard, Toronto's Director of Water Purification, to the Presidency. Then, to the job of selecting a successor to the Vice-Presidency and the choice was Louis R. Howson, Consulting Engineer, Chicago.

To serve as Treasurer for his fifteenth successive year, W. W. Brush was renominated.

Such nominations may be considered as tantamount to elections and automatically become so unless others are nominated before March 1st. New officers are seated at the close of the 1940 convention.

Honorary Members

Honorary Memberships were voted to four members, with the citations which follow:

George H. Fenkell, of Almont, Michigan, retired General Manager, Board of Water Commissioners, Detroit, Michigan; the chief of that city's water department during a period of rapid expansion which called for the combination of high engineering ability and management skill; A.W.W.A. member since 1920; President, 1931.

•

James E. Gibson, of Charleston, South Carolina, General Manager of that city's water department; a water works executive who has the fullest respect of his community; who has guided many younger men into effective service to the water works field; A.W.W.A. member since 1922; President in 1928.

•

John A. Kienle, of New York, N. Y., Vice-President of Mathieson Alkali Works, Inc.; the Secretary of the Water Purification Division for the first five years of its existence; for many years the Secretary and a guiding spirit of the Water Works Manufacturers Association; member of the A.W.W.A. since 1909; Director, 1936-8, 1939-.

Herbert M. Lofton, of Chattanooga, Tennessee; formerly Superintendent of Water Works of Savannah, Georgia; founder and General Manager of the Columbian Iron Works; responsible for the development of many useful improvements in water works equipment; A.W.W.A. member since 1895.

The Diven Medal Award

The John M. Diven Medal awarded to that member performing an "outstanding service to the Association" was voted to:

W. Victor Weir, Superintendent - Engineer of the St. Louis County Water Company, University City, Missouri, for his outstanding work as chairman of the Association's committee on "Distribution System Records" — one of his many services to the water supply field.

•

The Goodell Prize

The John M. Goodell Prize awarded to authors of the most meritorious paper of the year was voted to:

Messrs. Thomas H. Wiggin, Consulting Engineer, of New York, N. Y., and Melvin L. Enger, Dean of Engineering, University of Illinois, Urbana, Illinois, for their scientific contributions in the preparation of the paper, "A Proposed New Method for Determining the Barrel Thickness of Cast Iron Pipe," which was published in the Journal of the Association in May, 1939. This paper was selected because it represents painstaking research, scholarly interpretation of results, adequate technical analysis and presentation of matter of great importance in the water works field.

Something of the Growth of the Association

The Board found some pleasure in reviewing the statistical data revealing income, expenditures and membership in the Association, year by year, since January 1, 1936—all three being of continuing increase until now A.W.W.A. is very close to a

$100,000 per year operation when it is realized that the anticipated income for 1940 is set at a few dollars only under $98,000 and expenditures (including funds to be invested) amounting to a slightly less figure.

In examining the financial records of recent years, it was pointed out by Reeves Newsom, immediate past president and member of the Executive Committee, that in the face of the considerably higher cost of operating the Headquarters Office, since reorganization and staff enlargement, the 1939 ratio of total salaried expense to net income was considerably less than it was four years ago. And equally pronounced was the lower ratio of salaries paid to the number of members in 1939 as against that prevailing the year preceding the reorganization and the employment of the present Executive Secretary, who has shown what expert management is worth. In this direction all records speak for themselves, but none more conclusively than gains in Journal advertising and the membership gain record to-wit—as of:

Jan. 1, 1936	2,682
Jan. 1, 1937	2,724
Jan. 1, 1938	3,064
Jan. 1, 1939	3,359
Jan. 1, 1940	3,710

In this exhibit the largest annual gain in the history of A.W.W.A.—351 members—is recorded for 1939, the average for the previous two years of the new regime being 317 per year.

It was noted, too, that the Association now has invested $46,750, of which $6,258.75 represents investment during 1939 from funds received during the year and an additional $2,406 was invested in paper stock to be used during 1940, and which would at this writing cost the Association considerably more than the 1939 prices.

Committee Work Reviewed and Appraised

An impressive review and appraisal of A.W.W.A. Committee work of the year was presented by Malcolm Pirnie, Chairman of the Water Works Practice Committee. In this report requiring 13 pages of single space typing, the most impressive parts concerned progress and attainments by the following subcommittees.

Steel Pipe

Especial attention was drawn to the very fine and speedy progress made in 1939 by the Committee on Steel Plate Pipe under Chairman Wm. W. Hurlbut, and emphasis was placed on the fact that several of the tentative specifications were even now ready for printing in the January, 1940, Journal. A vote of thanks was given past-President Hurlbut and his committee for the splendid progress made in such a brief time. The tentative specifications will be discussed on the floor of the Kansas City Convention.

Cast Iron Pipe

Already in print in the December, 1939, Journal is the assembly of three of the *final* specifications covering Cast Iron Pipe, which were approved by the Board at its last meeting. What these new A.W.W.A. Specifications on Cast Iron Pipe mean to the users of pipe will be analyzed on the floor of the Kansas City Convention. (For purchase as separate documents, reprints of the specifications are now available at the A.W.W.A. offices, 22 East 40th Street, New York City).

Ready now for pre-printing and action by the Board, preparatory to printing in the Journal, is the report of the sub-committee on "Coal Tar Drip Coatings".

Distribution System Records

The excellent document of "Recommended Practices in Maintaining Distribution System Records," prepared under the leadership of Chairman W. Victor Weir, received the approval of the Board, with commendation of the chairman and his committee. It will in due time be printed in the Journal and reprints will be produced as separate documents for sale to members at cost; to others at a reasonable profit. (It was for this splendid contribution that Mr. Weir was cited, and will receive the Diven Medal.)

In the March, 1939, Journal the approved Standard Specifications for Gate Valves was printed. A large number of reprints of this set of specifications have been purchased and distributed in the field.

Completion of the work of the Joint Committee on Fire Hydrants (N.E.W.W.A. and A.W.W.A.) has been a problem due to differences of opinions of committee members on that part of the Specifications relating to hydrant barrel thickness. Until this Board meeting the deadlock persisted. Members of the Committee appeared before the Board to argue the differences of opinion. Such proved a happy solution to the problem of securing agreement. The discussions cleared up points of dissension with the gratifying result of an agreement by all members to accept the thickness and tolerances in the new Specifications for Pit Cast Class 250 C.I. Pipes as the minimum wall thickness for hydrant barrels. With this gap closed, the Specifications for Fire Hydrants are ready for final review by the Board and publication in the Journal. So, here is another milestone of progress passed in the needed revisions of A.W.W.A. specifications on water works equipment and practices.

Status of A.W.W.A. Publications

In the report of the Publication Committee, presented by L. H. Enslow, Chairman, it was revealed that the Journal for 1939, with its 2,194 pages of text, plus the supplementary 88-page section devoted to Cast Iron Pipe Specifications, constituted the most extensive volume in A.W.W.A.'s history.

Looking ahead with the onset of the European war, the far-sighted Secretary and Editor had purchased 37,461 lbs. of paper stock supply for the Journal well in advance of 1940 requirements, at a cost of approximately $2,406. Already the wisdom of such advance purchase had been proven in price rises which showed a saving of A.W.W.A. funds amounting to roughly $500.

The sale of 1,619 copies of the 8th Edition of Standard Methods of Water Analysis during 1939 had netted the Association a profit of $773.08, and a like amount to the American Public Health Association as joint sponsor and publisher.

Of the new Manual of Water Works Accounting, produced jointly by the Municipal Finance Officers Association and A.W.W.A., 840 copies have been sold, indicative of the demand for this guide and evidence of its acceptance and a position comparable to the old Manual of Water Works Practice.

The Manual of Quality and Treatment of Water has suffered an unexpected delay in appearance due to illness of Professor L. V. Carpenter, who has been in charge of its final editing. The text, however, has passed the galley stage and this new text should issue definitely before the Kansas City Convention in April. It is proposed to sell the Manual to members at $2.50; to non-members at $3.00.

The next reference text to be produced by the Association should be a Manual on Distribution Practice—thus giving the Association three rather up to date Manuals—"Water Quality and Treatment;" "Accounting;" and "Distribution Practices." The Board gave its "go-ahead" to this proposal to start developing the Manual of Distribution Practices.

THE KANSAS CITY CONVENTION

April 21-25, 1940

SOMETHING of the Technical Program for the Kansas City Convention has been mentioned in the preceding account of the Annual Meeting of A.W.W.A.'s Board of Directors.

The program, which is rapidly nearing completion, was reviewed for the benefit of Board members, discussed and approved. It was noted that the major theme of this year's program is MANAGEMENT; and, in the matter of water quality and treatment, CORROSION CONTROL and TASTE and ODOR CORRECTION is given the center of the stage. By the date of the next issue of this magazine the program should be ready for publication in essentially its completed form. Suffice it to say here that it is amply diversified, will contain some surprises perhaps, and has met with a high degree of approval by the Board.

Convention Exhibits Expansion

So sufficient is the space available for equipment and materials exhibits in the Kansas City Auditorium, that this year enlarged booths are being set up to better than ever make the exhibit hall a real "Water Works Equipment Show".

In addition to water works equipment the Board gave the Manufacturers' Association full approval of their plan to add exhibits of sewerage equipment, and to invite manufacturers of such equipment to take space for the purpose of displaying their wares and devices. So, those who are fortunate enough to get to the Kansas City Convention will find the greatest "Water Works *and* Sewerage Show" ever assembled under one roof. This fact should encourage attendance by those who have an interest in both fields or a greater interest in sewerage and sewage treatment than in water supply. Already, however, there is evidence enough that the attendance at the Kansas City Convention is to exceed earlier estimates, and this indication has been responsible for arranging for allocation of an increased number of rooms in hotels offering the most acceptable rates in the immediate vicinity of the Auditorium.

An Imposing List

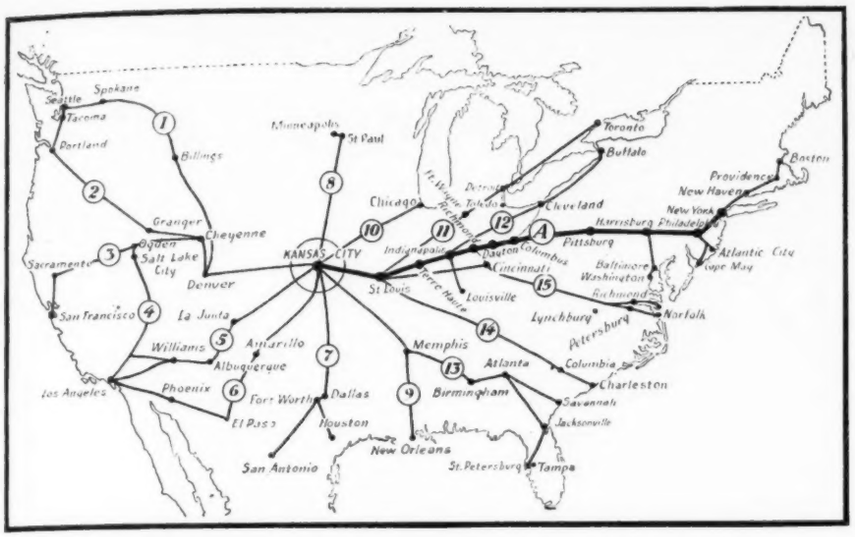
The following is the preliminary listing, as of February 5th, of those firms which have reserved space for exhibits. This list was prepared before authorization to add sewerage equipment and consequently those firms solely engaged in producing sewerage equipment do not yet appear on the list.

The Kansas City Auditorium—Hotel and Business District
(*Believed to offer most perfect convention facilities of any in America*)
See manuscript—page four.

*Applicants for Space**

Activated Alum Corp.
American Cast Iron Pipe Co.
American City Magazine
American Rolling Mill Co.
Atlas Mineral Products Co.
Badger Meter Mfg. Co.
Barrett Company
Birch Mfg. Co.
Buffalo Meter Corp.
Builders Iron Foundry
Carson Cadillac Corp.
Calgon, Inc.
Central Foundry Co.
Chapman Valve Mfg. Co.
Chicago Bridge & Iron Co.
Chicago Pump Co.
Cliffs Dow Chemical Co.
Crane Company
Darco Corp.
Darling Valve & Mfg. Co.
DeLaval Steam Turbine Co.
Dorr Company, Inc.
Dresser Mfg. Co.
Eddy Valve Co.

* This list was supplied by J. Herman Smith, Chairman of the Exhibits Committee of the Manufacturers' Association.



Suggested A.W.W.A. Convention Routings

(Shortest and Best Routes to Kansas City)

Route of the A.W.W.A. Special via Pa. Ry. to St. Louis and Burlington into Kansas City

1—Milwaukee Road, Great Northern or Northern Pacific & Burlington Route.

2—Union Pacific Railroad.

3—Southern Pacific & Union Pacific.

4—Union Pacific Railroad.

5—Santa Fe Railway.

6—Southern Pacific—Rock Island.

7—International Great Northern and Missouri, Kansas, Texas.

8—Rock Island Lines.

9—Illinois Central & Frisco Lines.

10—Santa Fe, Milwaukee Road or Burlington Route.

11—Grand Trunk, Wabash and Burlington Route.

12—New York Central and Burlington Route.

13—Southern Railway and Frisco Lines.

14—Southern Railway and Burlington Route.

15—C. & O. and N. & W.—Big Four and Burlington Route.

Electro Rust-Proofing Co.
Engineering News-Record
Farnan Brass Works Co.
Flexible Sewer Rod Equip. Co.
Ford Meter Box Co.
Foxboro Company
General Paint Corp.
Hayman, Michael & Co.
Hays Mfg. Co.
Hersey Mfg. Co.
Homelite Corp.
Hydraulic Development Corp.
Industrial Chemical Sales
International Filter Co.
Iowa Valve Co.
Johns-Manville Sales
Keasbey & Mattison
Kennedy Valve Mfg. Co.
Layne Bowler Co.
Lead Industries, Asso.
Leadite Co.
Lock Joint Pipe Co.
Ludlow Valve Mfg. Co.
M & H Valve Fittings Co.
McWane Cast Iron Pipe Co.
Monsanto Chemical Co.
Mueller Co.
National Meter Co.
Natl. Water Main Cleaning Co.
Neptune Meter Co.
Omega Machine Co.
Pardee Engineering Co.
Permutit Company
Phoenix Meter Corp.
Pitometer Co.
Pittsburgh-Des Moines Steel Co.
Pittsburgh Equitable Meter Co.
Proportioneers
Public Works
Rensselaer Valve Co.
Ross Valve Mfg. Co., Inc.
Salamon, L. A., & Bro.
Simplex Valve & Meter Co.
Smith, A. P., Mfg. Co.
Sparling, R. W.
Steel Protection & Chem. Co.
Thomson Meter Co.
U. S. Steel Corp. of Delaware
Vogt Mfg. Co.
Wailes Dove Hermiston Corp.
Wallace & Tiernan Co.
Water Leak Detector Co.
Waterous Company
Water Works Engineering
Water Works & Sewerage
Wood, R. D., & Co.
Worthington-Gamon Meter Co.
Youngstown Sheet & Tube Co.

SCHEDULE OF THE A.W.W.A. SPECIAL

Saturday, April 20—	
Lv. New York—PRR	11:55 A. M.
Lv. Newark	12:10 Noon
Lv. Elizabeth	12:18 P. M.
Lv. New Brunswick	12:34 P. M.
Lv. Trenton	12:59 P. M.
Lv. Atlantic City—PRSL	11:45 A. M.
Ar. North Philadelphia	1:01 P. M.
Lv. North Philadelphia	1:26 P. M.
Lv. Washington—PRR	7:35 A. M.
Lv. Baltimore	8:26 A. M.
Ar. Harrisburg	10:45 A. M.
Lv. Harrisburg	3:17 P. M.
Lv. Altoona	5:44 P. M.
Lv. Pittsburgh	8:25 P. M.
Sunday, April 21—	
Lv. Columbus	12:30 A. M.
Lv. Indianapolis	2:45 A. M.
Ar. St. Louis	7:55 A. M.
Lv. St. Louis—Burlington Rt.	8:40 A. M.
Ar. Kansas City	2:00 P. M.

Members from Toronto, Detroit, Buffalo and Cleveland are invited to join party at St. Louis.

Convention Routings

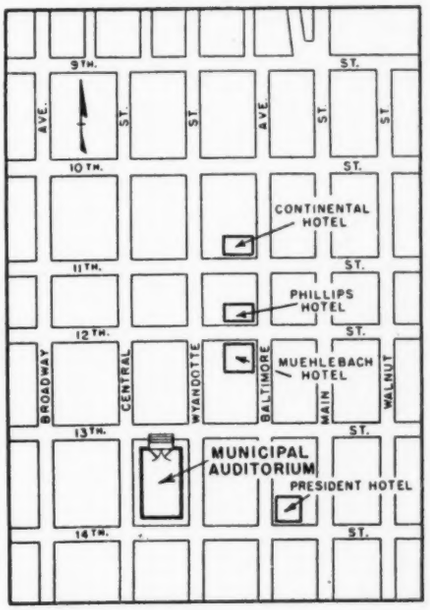
That old "wheel-horse" — John Warde — committee chairman who has handled transportation arrangements for so many A.W.W.A. conventions of past years, is again in harness as evidenced by the major routings developed to Kansas City and indicated on the accompanying map recently mailed to all members of the Association.

The routing of the annual A.W.W.A. Special is shown and likewise its schedule. For schedules applying to other routes and rates see your local railway agent or address John S. Warde, Chairman Transportation Committee, 50 Church Street, New York City.

Hotels and Rates

The accompanying map shows the location of the four hotels selected by the Convention Management Committee as co-headquarters hotels because of convenience in location, rates and other desirable qualities. Reservations made to date have passed those anticipated for the Kansas City Convention and, therefore, if the more reasonable rates allowed on rooms held for A.W.W.A. convention attendants are to be had it is well to make reservations without delay.

Relative Location of Auditorium and Co-Headquarters



Rates for single and double rooms are shown in the accompanying schedule:

Accommodations	Phillips	President	Muehlebach	Continental
Single Bedroom	$2.50-$5.00	$2.50-$5.00	$3.50-$ 6.00	$2.50-$4.00
Double Bedroom, 2 persons	4.00- 8.00	4.00- 6.50	5.00- 8.00	3.50- 6.00
Twin Bedrooms, 2 persons	6.00- 8.00	5.00- 8.00	6.00- 10.00	

(For locations of hotels in reference to Auditorium see accompanying map.)

Rates on suites of one bedroom and parlor are $12.00 and $15.00 except at the Muehlebach, where such accommodations are $15.00 and upwards.

N.J. SEWAGE WORKS ASSOCIATION'S
SILVER ANNIVERSARY PROGRAM

Looks Like a "Who's Who" Amongst Sanitary Engineers and Chemists

OUR January issue contained a brief account of special plans and preparations under way for the Silver Anniversary Convention of the New Jersey Sewage Works Association. The place is Trenton, N. J., March 20, 21, 22, with headquarters at the Stacy-Trent Hotel and a display of sewage works equipment of Silver Anniversary proportions in the War Memorial Building adjacent. Plans under way contemplate an attendance of 400 or better, attracted by the special program and show.

The caption of our January announcement read "A Sewage Works Convention of National Proportions"—now issues the Technical Program in essentially completed form to prove that the objectives of "Bill" Orchard, Chairman of Committee on Arrangements, and Harry P. Croft, Chairman of the Technical Program Committee, are taking real shape. The program released early this month by Chairman Croft has the appearance of a "Who's Who" amongst Sanitary Engineers and Chemists in the Eastern half of the United States.

If headliners mean nearly as much on a technical program as they do on playhouse billboards, the New Jersey Association will be hanging out the "S. R. O." sign soon after its Big Sewage Works Show gets under way in Trenton on March 20th.

Here are some of the Silver Anniversary headliners—Dr. Abel Wolman (John Hopkins); Dr. F. W. Mohlman (Chicago Sanitary District); Paul Hansen (Chicago); George Gascoigne (Cleveland); Dr. Max Levine (Iowa State College); Wellington Donaldson (N. Y. Dep't Public Works); Dr. Willem Rudolfs (N. J. Exptl. Station); W. M. Piatt (Durham, N. C.); Frank Bachmann (New York City); Dr. George Ornstein (Berlin, Germany).

But it is not all "headliners" that make the program of unusual interest.

The small plant operator will have his day at court, as evidenced by the full afternoon session devoted exclusively to a number of brief papers by operators—for the most part operators from small plants. The topics have been assigned on the basis of evidence of greatest interest, as determined by replies to a questionnaire asking operators—"What do you wish most to hear discussed during the Silver Anniversary Convention?" A panel discussion will follow the papers—so, the small operator will be well served.

THE PROGRAM

Wednesday, March 20th

(*Forenoon*)

Registration, exhibits, etc.

(*Luncheon*)

Roof Garden, Stacy-Trent Hotel.

Speakers introduced by Edward P. Molitor, President of the Association.

Speakers: John R. Downes, First President of the Association 25 years ago.

Dr. J. Lynn Mahaffey, Director, N. J. State Dept. of Health.

Hon. A. Harry Moore, Governor of N. J.

(*Afternoon Session*)

Sewage Treatment Practices in Foreign Lands, by Frank Bachmann, The Dorr Co., New York City, N. Y.

Some Observations on Trickling Filters, by Dr. Max Levine, Iowa State College, Ames Iowa.

Construction of Sewage Treatment Plants under the Provisions of Section 40:1-79 of the Revised Statutes of N. J. (Sewer Rentals) by Hon. R. C. Hendrickson, Woodbury, N. J.; William H. Boardman, Jr., Philadelphia, Penna.

Construction of Sewerage Systems or Sewage Treatment Plants under the Provisions of sub-division (g), Section 40:1-16 of the Revised Statutes (An Order of Necessity) by S. A. Kowalchik, Trenton.

Laws Relating to the Licensing of Those in Charge of Sewage Treatment Plants—Article 5, Title 11, Section 58 of the Revised Statutes and Chapter 206, P. L. 1938, by D. M. Ditmars, Trenton.

Final Report of the Committee on Gas Hazards at Sewage Treatment Plants, by L. W. Morrill, Secretary, Trenton.

Discussion by Morris M. Cohn, Schenectady, N. Y.

(*The First Evening*)

Smoker and Get-Together—Roof Garden, Stacy-Trent Hotel.

Thursday, March 21st

(*Forenoon Session*)

The Installation and Operation of a Small Dairy Waste Treatment Plant, by C. M. Nichols, Trenton.

The Construction of Sewage Treatment Works and Its Relation to the National Economy, by Abel Wolman, Johns Hopkins Univ., Baltimore.

What Has Been Learned Concerning the Disposal of Sewage Sludge at Cleveland, Ohio, by George B. Gascoigne, Consulting Engineer, Cleveland.

(*Afternoon Session*)

Some Experiences Gained in Sewage Treatment at Buffalo, New York, by Paul Hansen, Consulting Engineer, Chicago.

Some of the More Interesting Aspects of Chicago's Operations, by F. W. Mohlman, Chicago Sanitary District.

Developments and Trends in Sewage Treatment, by Linn H. Enslow, Editor, N. Y. City.

The Need for a Strong National Sewage Works Association, by William J. Orchard, Belleville, N. J.

(*Second Evening*)

Dinner in Celebration of the Silver Anniversary of the N. J. S.W.A.

On With the Show!
Friday, March 22nd
(*Forenoon Session*)

Business Meeting.

The Manasquan Sewage Treatment Plant and Methods Used for the Abatement of Odor Nuisances, by J. K. VanBrunt, Manasquan.

Some Experiences With Gas Engines, by W. M. Piatt, Cons. Engr., Durham, N. C.; N. C. Wittwer, Rahway, N. J.

Discussion

What Research has Yielded Recently, by Dr. W. Rudolfs, New Brunswick, N. J.

(*Afternoon Session*)

A Symposium on Practical Plant Operation:

The Control of the Sprinkling Filter Fly by Spraying, by Walter Allegar, Flemington, N. J.

The Control of the Sprinkling Filter Fly by Flooding, by Joseph H. Wells, Westmont, N. J.

Comparison Between Analyses and Turbidimeter Readings, by E. A. Bell, Essex Fells, N. J.

Maintenance of Pumping and Screening Station, Cape May, by George P. Wentzell, Cape May City, N. J.

Pre-Treatment of Industrial Wastes, by William J. Kee, Bound Brook, N. J.

Pre-heating of Scum and Sludge before Discharge to Sludge Digester, by Theodore Eggertson, New Brunswick, N. J.

Experience with Slow Sand Filters in Sewage Treatment, by W. C. Mallalieu, Boonton, N. J.

Infiltration, Location and Repairs of Leaks, by Joseph R. LeChard, Atlantic City, N. J.

Vacuum Drying and Incineration of Raw Sewage Sludge, by Harold Parsells, Town of Raritan, N. J.

Removal and Incineration of Sludge, by J. K. Adams, Tenafly, N. J.

Panel Discussion of the Above Papers.

(At the close of the Technical Session the Committee on Arrangements promises something novel in the way of entertainment.)

"ZODE SMITH'S ANNIVERSARY"

SUCH was the caption of an editorial appearing recently in Atlanta's oldest and most important newspaper, *The Atlanta Journal.*

This editorial appeared on January 23rd, the day following a testimonial dinner to Zode Smith by Water Department employees in celebration of his 50th year in the City's service. For better than 30 of these years he has been at the head of the Water Department. Zode Smith's Golden Jubilee Celebration was participated in by 300 employees and city officials, including the Mayor.

It was interesting that the Journal's editorial writer nowhere mentioned Mr. Smith's present position. We will have to assume that the Journal just reasoned that everybody in Atlanta knew that Zode Smith was the Water Department Manager. We think that was fine. We think the whole editorial was fine, and here it is.

Zode Smith's Anniversary

That was a typically modest and gracious gesture which W. Zode Smith made Monday evening at the dinner at which three hundred citizens were celebrating his fiftieth anniversary as an employee of the City of Atlanta. He had been praised by Mayor, Councilmen and civic leaders for his distinguished services. In reply, he asked all employees of his department to stand, then he said to the Mayor and Councilmen: "Gentlemen, here is your water works, and a fine one."

That, of course, was true, yet the very fact of its verity was the finest of compliments to Mr. Smith himself. The ablest executive is he who adds to mastery of technique those personal qualities which enable the building of an efficient and loyal staff—an organization which functions with the precision of a well-constructed and correctly lubricated machine. So, in expressing his obligation to his force, Mr. Smith was, quite unintentionally and, therefore, pardonably, praising himself.

But Zode Smith needs no self-praise. Atlanta is proud of its water works system, which may well be taken as a model of publicly owned utility by the nation at large, and Atlanta is proud of the personnel that conduct it, from general manager down to humblest employee.—*Atlanta Journal.*

It is to be noted that the Mayor and the members of Council were on hand to honor Mr. Smith and to pay tribute to the efficient operation of Atlanta's Water Department.

The following words pertaining to Mr. Smith have been taken from a letter to us from Paul Weir, Sup't of Filtration at Atlanta, concerning his boss and friend, Zone Smith:

"Mr. Smith is truly a great man, because of the fact that he has not only served the people of Atlanta efficiently and diligently for the past fifty years, but has also spread his psychology of perseverence and achievement among all with whom he has come in contact, especially the water works engineer of the South. He is a man not given to personal effervescence. He manages his department in a manner similar to that of one large family. In my humble judgment, Mr. Smith stands as a monument to all future public employees in that he has been held in highest esteem for many years by the most critical employer known to mankind—the public."

We wish that there were more Zode Smiths, and more *Atlanta Journals* to help build the excellent public relations enjoyed by Atlanta's Water Department.

"WROUGHT IRON"

(*A Review*)

Authors—James Aston and Edw. B. Story.
Publisher—A. M. Byers Co., Pittsburgh, Pa.

"Wrought Iron"—in its second edition has appeared in the form of a 97-page volume by the Consulting Metallurgist and the Chief Metallurgist of A. M. Byers Co., who have revised their popular first edition, to include the most up to date information on wrought-iron manufacture, characteristics and applications.

The book contains nine chapters and many beneficial illustrations to tell "the story of wrought-iron" in an effective manner. Although we have only scantily examined the new edition, it can readily be appreciated why the earlier edition received such wide distribution and adoption as a text in more than 100 technical schools and colleges.

The price listed is $1.00, but we are advised that anyone writing on his own letterhead or that of his firm may have a copy gratis. So, in either event, we can say that "Wrought Iron" is worth much more than the published price. The only requirement is a letter of request to G. B. Cushing, Promotion Manager, A. M. Byers Co., Pittsburgh, Pa.

A DECADE OF SEWERAGE BEYOND COMPARE

DR. MOHLMAN, in his review of "Progress and Trends in Sewage Treatment," featured in this issue, has with high justification referred to the '30's as a decade of sewerage developments and sewage treatment progress in America which has no parallel.

Many of us will look back for some years to come on the last half of this decade of 1930-1940 as the golden era of attainments in the expansion of sewerage facilities and sewage treatment progress. However, in looking at the giants amongst sewage treatment plants, such as the huge Ward's Island Plant of New York City and Chicago's colossal Southwest Plant, just put into service to fittingly close the decade, one must not lose sight of the many hundreds of plants and complete new systems which came into being in the smaller communities.

As the Doctor so pictorially puts it—the rains of P.W.A. and W.P.A. loans and grants came and the seeds already planted took growth. Plants popped up here and yon, and grew as never before. New processes appeared; chemical precipitation staged an exciting come-back; improved chemicals appeared at prices justifying their greater use in sludge dewatering and sewage treatment; the recovery of power as a by-product through use of gas engines, in plants both large and small, proved the most romantic achievement; the sale of sludge as a soil improver added more interest to the prosaic community service of sewage treatment; vacuum filtration of sludges was put on a more substantial and economical basis; heat drying and incineration of sewage solids was perfected, to provide a more cleanly and nuisanceless solution of the screenings and sludge problem at costs proven well within justification; mechanical flocculation and the filtration of effluents, at justifiable costs, established themselves; stage digestion of solids became an accepted advancement; so-called "high-rate" or "bio-filters," operating at unheard of loadings, were developed; elutriation of digested sludges constituted another innovation; "aero-chlorination," as a commanding achievement in improved grease separation, appeared; chlorination in its numerous ramifications expanded; and, colossal chlorinator installations came into being at important plants, to add impressiveness to the advancing use of chlorine.

"Tools" of the sewage works operator were vastly increased in numbers and quality, to provide greater flexibility of plant operation, reduction of manual labor and dependable nuisanceless performance. Mechanical and electrical devices were radically improved, and increasingly used, until now mechanical and electrical engineering in plant operation has attained importance of equal or greater magnitude than biological and chemical phases of operation.

For a statistical picture of the decade's expansion in sewerage and treatment facilities we need only examine the records of the two Federal agencies—P.W.A. and W.P.A. In the smaller communities W.P.A. has aided in the construction of at least 325 new treatment plants and in betterments to 200 existing plants. In addition, more than 7,000 miles of sewers have been constructed with W.P.A. assistance. In its program the combined expenditure by the agency and municipalities for such improvements has run in excess of $330,000,000. [These statistics lack in completeness of 1939 records, whereas those to follow are more authentic.]

In a recent recapitulation by P.W.A. the following are exact records through to 1940:

P.W.A. Sewerage Projects

Total Number of Projects	1,720
Total Expenditure	$478.000,000
Treatment Plants	920
Complete New Systems	426

But for the depletion of P.W.A. funds the stride would still be a notable one, when it is realized that applications for aid on 209 sewerage projects, having an estimated total cost of better than $132,000,000 had to be returned to the applicants.

Amongst the states to boast the largest number of projects are:

State	*No. of Projects*	*Expenditure*
Ohio	121	$37,552,749
New York	105	72,075,942
Wisconsin	100	26,490,904
Illinois	91	76,949,204
California	70	14,516,495
Pennsylvania	66	16,189,647

Iowa had 65 projects and Minnesota 58; Texas and New Jersey each had 55; Michigan and Missouri 54 each; Kansas and Massachusetts 51 each—the 52nd for Massachusetts being the important Boston project which was amongst the 209 returned by P.W.A. for lack of funds.

So, one must agree that it *has* been a decade of sewerage expansion that the world has never before seen.

L. H. Enslow

You Can Write the Order

THAT WILL END SEWER TROUBLES!

Here's a way to solve those difficult sewer problems once and for all. Specify Asbestos-Bonded ARMCO Sewer Pipe for economical repair work or new construction.

Asbestos-Bonded ARMCO Pipe meets every sewer line requirement. Its flexible corrugated design eliminates breakage and strong, tight joints greatly reduce the danger of infiltration. Long lengths mean fewer joints per mile and lower installation costs. Cradling is unnecessary.

Also important, ARMCO Sewer Pipe brings assurance of material durability. The galvanized ARMCO Ingot Iron is proved by a 33-year service record in sewers. Now a thick pavement in the bottom and full bituminous coating inseparably bonded to the pipe offer much longer service.

Many major cities have benefited by installing Asbestos-Bonded ARMCO Sewer Pipe. Yours can too. A request to us will bring you complete information with no obligation. Armco Drainage Products Association, 5010 Curtis St., Middletown, Ohio.

OFFICE OF PUBLIC WORKS

Jim —

Let's reline that old sewer with Asbestos-Bonded Armco Sewer Pipe. Then we can stop this continual maintenance expense and have a permanent job at less than half the cost of building a new sewer.

Mac

A disintegrating brick sewer is permanently repaired with Asbestos-Bonded ARMCO Sewer Pipe. Approximately 600 feet of 72-inch ARMCO Pipe was threaded into the sewer without interrupting street traffic and at less than half the cost of rebuilding.

ASBESTOS-BONDED ARMCO SEWER PIPE

ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS

EQUIPMENT NEWS

"Explosion Proof" Vibrators and Controllers

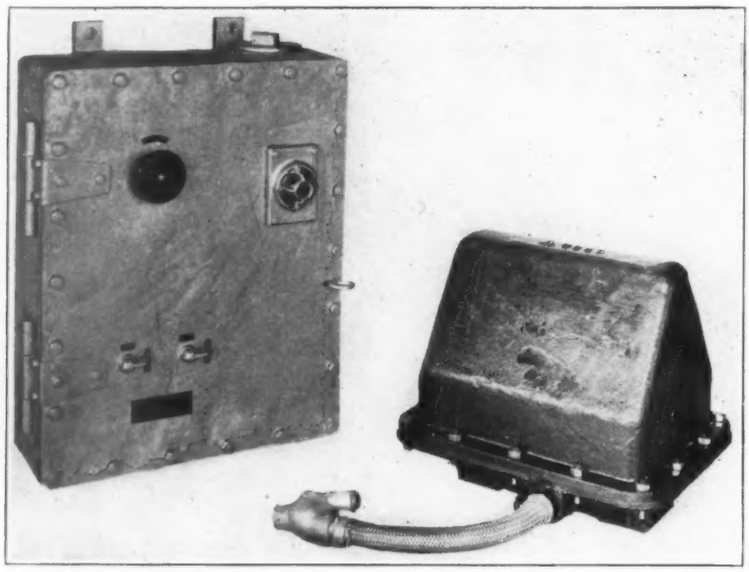
● The Syntron Company have just added to their line of Vibrators, an "Explosion Proof" model, for use in plants where atmospheric conditions may be inflammable or explosive.

These Vibrators are used for attachment to bins, hoppers, chutes, etc., to prevent arching over and hanging up of material, and to insure a free flow at all times.

The Vibrator, a heavy, pulsating electro-magnet, is fully encased in a thick, electric-furnace steel case, with ground joints, and with an armored cable lead.

The remote electric control panel containing the rectifier, operating switches and rheostat for controlling the Vibrator's power, is fully encased in a cast iron case, with ground joints and approved explosion proof fittings.

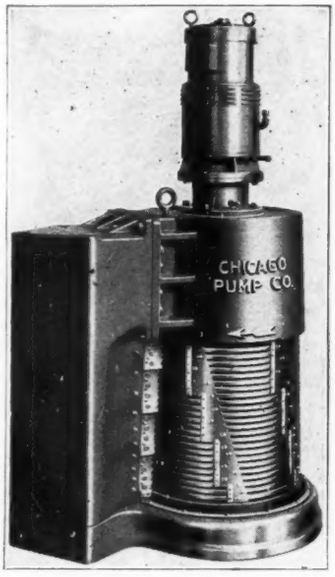
For further details write The Syntron Co., 650 Lexington Ave., Homer City, Pa.



Syntron's "Explosion Proof" Vibrator (right) and Control Box.

Comminutor Improvements Cut Power Requirements to Half

● During the past year several improvements have been made by Chicago Pump Co. in the design of their Comminutors, which serve as screens with a rotating element, to cut up coarse sewage solids under water. The net result of such improvements is a machine of increased capacity for a given size unit and, simultaneously, a cut in required motor size (power) to ½ that formerly required.



The more pronounced improvements include a reduction in clearances between the cutting teeth and the comb, thus securing a sharper shear action. The cutting teeth and combs at the same time have been staggered and a third cutting member (replaceable shear bars) have been added to insure the shearing of stringy materials more effectively and positively. These improvements made possible the reduction in number of cutting teeth. At the same time the cutters have been redesigned to permit greater ease in re-sharpening by grinding at the plant where used. Parts have been made heavier and ball-bearings added. And, long shafted Comminutors now have silent universal flexible couplings.

All such improvements have combined to make permissive the use of drive motors just one half the H.P. ratings of earlier models of like sizes.

For further information and new literature, write Chicago Pump Co., 2349 Wolfram Street, Chicago, Ill.

84" pipe—Spring Lake, N. J.

FLANGED PIPE
FLEXIBLE JOINT PIPE
BELL & SPIGOT PIPE
SPECIAL CASTINGS
SHORT BODY BELL & SPIGOT SPECIALS

Large stock enables us to make prompt shipments.

CAST IRON PIPE

SIZES 2" TO 84"

Warren Foundry & Pipe Corp.
11 Broadway, New York

Warren Pipe Company of Mass., Inc.
75 Federal St., Boston

A Combination Compressor and Truck Engine

● Schramm, Inc., has recently developed a combination truck engine and air compressor for replacing the regular engine under the hood of trucks.

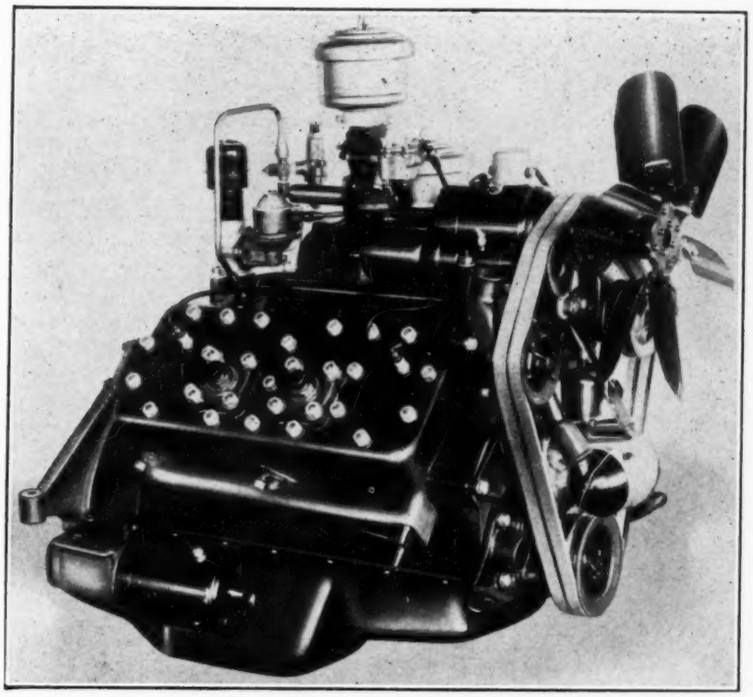
This novel unit is essentially a Ford V-8 engine which has 4 cylinders functioning as the engine, and the 4 alternate cylinders operating as an air compressor, which provides ample air for light duty work and the odd job which does not justify hauling out the heavy duty compressor. When not operating as a compressor the unit becomes a four-cylinder truck motor with the compressor cylinders merely idling.

Operating as a compressor the new Schramm combination unit delivers 55 cu. ft. of air per minute at 100 pounds pressure, sufficient for driving a heavy duty paving breaker, two demolition breakers, air motors to open and close gates, operate tapping-machines, blow out service lines and small mains, emptying large mains, purging manholes and sewers, to operate spray units, etc.

An outstanding advantage of this compressor unit is that the truck can't go out on a job without it. Another, is that it takes up no load space on the truck. A third, that 96% of the parts are identical to Ford parts and can be obtained in every village and hamlet the world over. The unit can, of course, be installed as a stationary engine-compressor unit.

The availability of the Schramm Fordair Unit for trucks will allow many of the smaller water and sewer departments to have compressors that ordinarily feel that a separate compressor cannot be afforded and consequently do without or rent a compressor when the necessity arises. The larger departments may now have as many of these self-propelling compressors as they have trucks, and that will mean many more operations with air motors and pneumatic tools, speedier work and fewer tedious and back-breaking manual operations.

For Bulletin 3915 presenting the Fordair Combination Unit, write Schramm, Inc., West Chester, Pa.



The Schramm Fordair Unit

Differential Controllers

Minneapolis-Honeywell Differential Controllers are designed with two bellows assemblies that oppose each other and react to variations in the difference in pressure or temperature between the high and low pressure or temperature elements.

The Differential Pressuretrol can be installed with an orifice to control the flow of steam or liquids, or it may be used as an alarm device on cooling water systems such as the supply line to water-cooled bearings on large generators, Diesel or gas-engines. It may also be used as an alarm on large refrigeration condensers.

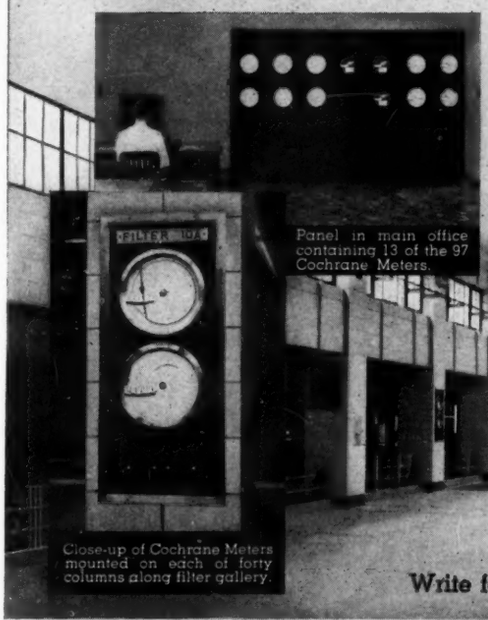
The Differential Thermostats are similar to the Differential Pressuretrols except that they are made up with temperature elements instead of the pressure bellows assemblies. They can be used for water conservation on air conditioning jobs using well water; in the control of sludge, digester temperature, etc., and to prevent condensation in underground rooms or tunnels where it is necessary to maintain the temperature above that of the outside air.

Both the Differential Pressuretrols and the Differential Thermostats are available in modulating as well as "make and break" mercury switch models.

For literature and prices write Minneapolis-Honeywell Regulator Company, 2950 Fourth Avenue South, Minneapolis, Minn.

97 Silent Engineers

at Cincinnati Filtration Plant



Panel in main office containing 13 of the 97 Cochrane Meters.

Close-up of Cochrane Meters mounted on each of forty columns along filter gallery.

THE ninety-seven Cochrane Meters at the Cincinnati, Ohio, filtration plant are virtually silent engineers — accurately determining and recording liquid level, temperature, Venturi flow, loss of head, effluent and influent.

Cochrane offers a complete line of meters for every type of waterworks and sewerage application —meters that are guaranteed for their dependability and accuracy.

Write for Publication 2096.

COCHRANE CORP., 3137 N. 17th STREET, PHILADELPHIA, PA.

COCHRANE

Flow Meters

on Bell and Spigot Jointing!

Tegul-MINERALEAD saves time, labor, trouble and money • Quick healing of that initial leakage speeds up the work; no skilled labor is needed • The Ingot form is easy to handle, store and ship, is impervious to snow, rain and flood—and averts possible composition change in transit • Makes joints permanently tight, elastic, vibration-proof, more resistant to thermal and mechanical shock • You owe it to yourself to get more information. Write to The ATLAS MINERAL Products Company of Pa., Mertztown, Pennsylvania.

Tegul-MINERALEAD

Turco Midgets for Small Sewers

● Turbine Sewer Machine Co., of Milwaukee, manufacturers of the well known TURCO SEWER FLUSHERS for large sewers, are now offering TURCO MIDGETS, which do the same job on the smaller size sewers and drains—4" and 6". They have connections for ¾" hose.

Like the larger TURCO FLUSHERS the Midgets are worked into the pipe deflated. Upon turning on the water pressure the elongated bag inflates to serve as a plug and allows full water supply pressure to be exerted on the stoppage downstream from the flusher.

The bags of the new Midgets have a special heavy duty rubber cover and several plies of strong canvas, inside of which is an inner tube. These reasonably priced smaller units are of the same construction as the larger TURCOS and carry identical guarantees of "Perfect Service or Full Credit."

For a descriptive leaflet and price listing write Turbine Sewer Machine Co., Milwaukee, Wisc.

FLASH

Considerable reduction in price has been made in all models of The Meter Master.

You can now purchase The Meter Master for as low as $176.00.

WRITE FOR DETAILS

F. S. BRAINARD & CO.
246 Palm St.
HARTFORD, CONN.

Prevent wear and cutting of rods, plungers, shafts and valve stems by using

MABBS RAWHIDE PACKING

In Your Water Works and Sewage Plants

IT LASTS LONGER—*Is Anti-Frictional, Saves Power, Labor and Repairs. Will prove the cheapest packing that can be bought.*

Trade Mark Reg. U. S. Pat. Off.

Mabbs Hydraulic Packing Co.
Incorporated 1892
431 S. Dearborn St., Chicago, U. S. A.

FERRIC ISCO CHLORIDE

For Sewage and Water Treatment have you tried

• ISCO •

Ferric Chloride . . . . .
SOLUTION or CRYSTAL?

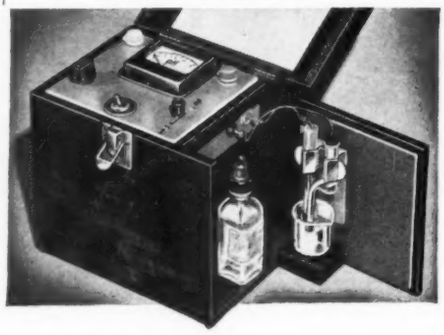
FOR SLUDGE CONDITIONING—Ferric Chloride is accepted as the agent most efficient from the standpoint of performance and cost.

FOR COAGULATING SEWAGE—Ferric Chloride provides an inexpensive and effective method of dealing with plant overloads.

FOR WATER PURIFICATION—Ferric Chloride is an economical and practical coagulant, and gives quick-forming, fast-setting floc. Write

INNIS, SPEIDEN & CO.
117 LIBERTY STREET, NEW YORK, N. Y.
Chicago Cleveland Boston
Philadelphia Gloversville, N. Y.

The "One-Two" Cameron pH Tester



● Wilkins-Anderson Co. of Chicago are offering an improved and very moderately priced pH instrument which makes use of the well known Cameron Red Bulb Glass Electrode.

The compact "One-Two" pH Tester is announced as the new "baby" of the Cameron line. It has been produced to fill a demand for a moderate priced direct reading pH instrument to fit all needs of the smaller laboratories and to serve as a readily portable self-contained pH tester for use at various spots. It is, in fact, hardly more than a handful.

As to simplicity of use, the "One-Two" is descriptive of the two simple operations required to obtain readings in pH value direct—no conversions or computations.

Readers interested in possessing a low cost direct reading pH instrument will find interesting reading (especially the price figure) in the new Cameron Bulletin No. 42WW. For a copy write Wilkins-Anderson Co., 111 No. Canal St., Chicago.

ARROWHEAD Grating and Treads

Engineers' Handbook sent on request

ARROWHEAD IRON WORKS

431 W. 5th Street
Kansas City, Mo.

When you think of
ALUM
. . . think of
ACTIVATED
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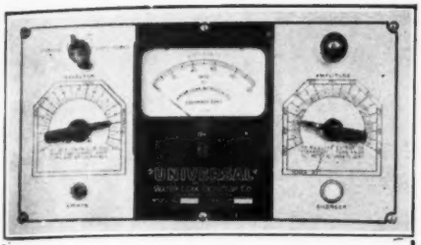
ACTIVATED ALUM CORPORATION
Curtis Bay Baltimore, Maryland



WATER LEAK

detection and location problems have been satisfactorily answered by many practical water works men, since they abandoned the old fashioned listening devices, and adopted the modern and up-to-date

"UNIVERSAL METHOD"

of locating leaks, which measures leak vibrations on a visual meter. As these vibrations increase or decrease, the operator knows he is going towards or away from the leak. Likewise, he knows when he has spotted the leak.

We train your men the "Universal Method" at no extra cost.

PIPE LOCATION:—Since no one type of pipe locator will locate all pipe and fixtures under all conditions, therefore we manufacture two types. Our Energizer type locates pipe under reinforced concrete pavements. Our T-R type locates pipes, short stubs, tees, crosses and buried valves, etc.

Why not write for illustrated literature, or better yet, ask for a demonstration in your own city.

WATER LEAK DETECTOR CO.
166 N. Third Street
Columbus, Ohio

LEADITE

The Pioneer Self-Caulking Material for C. I. Pipe

POURING A LEADITE JOINT ON A LARGE DIAMETER PIPE

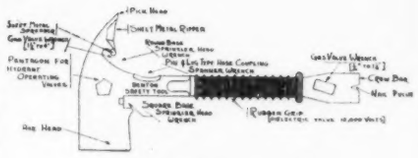
—a familiar sight to Engineers, Water Works men and Contractors most everywhere.

REMEMBER . . . . . .
LEADITE has been tested and used for over 35 years under all conditions of water main construction!

THE LEADITE COMPANY
Girard Trust Co. Bldg., Phila., Pa.

No Caulking

A Tool of 101 Uses +



Benton Safety Tool

● With the above illustrations very little need be stated in words to convince one of the more than 101 Uses to which such an instrument as the Benton Safety Tool can be put. It may be said that it is a tool for every service, utility or emergency truck of every water and sewer department.

This unique tool, developed by Benton Tool Corporation of Cleveland, Ohio, is manufactured from high carbon steel and then chrome plated. It is 18 inches long, overall, and the sure grip handle and safety heel is rubber "plated" for protection against electric shock up to 12,000 volts. The axe blade is a real one and the pick head has a ⅜" chisel point. Note the pentagonal hole for turning hydrant stems and does the job of a spanner wrench also. It also has a hole for turning corporation and curb cocks. The tool weighs 3¾ pounds and a specially designed holster is available for wearing attached to the belt.

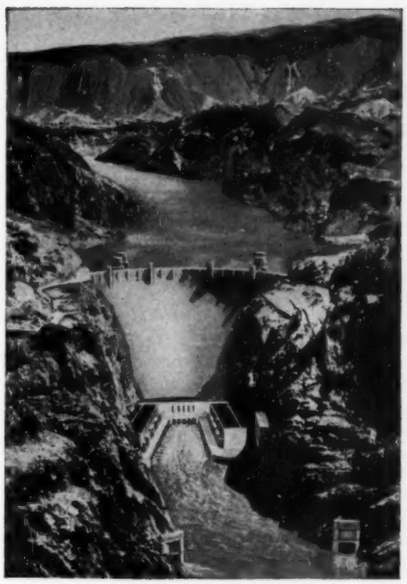
For descriptive folder and price write Benton Tool Corp., 425 Engineers' Building, Cleveland, Ohio.

Fabricated Fittings of "Everdur" and Copper

● The American Brass Company is now offering fabricated flanged fittings of copper or the highly resistant Silicon-Copper alloy "Everdur" for the larger size lines of copper or "Everdur" tubing.

The manufacturer points out that these fabricated fittings cost less than cast fittings, are not as porous, have smoother interior surfaces, are lighter in weight, and more flexible. In a new bulletin a variety of the new fittings are illustrated and listed in regard to dimensions and prices.

For a copy of "Copper and Everdur Fabricated Fittings" write The American Brass Co., Waterbury, Conn.



Bailey Meters AT

BOULDER DAM

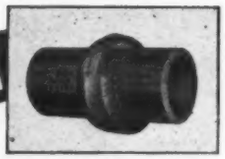
● In Boulder Dam Power Plant as in many other new hydro-electric stations including Madden Dam and Norris Dam, Bailey Fluid Meters are installed on hydraulic turbines.

At Boulder Canyon, the Bailey Meters measure water supply through 13 foot diameter penstocks under an average head of 530 feet. These meters indicate and record the water flow in terms of cubic feet per second and continuously integrate in millions of cubic feet. The registers are operated by pressure connections in the turbine scroll casings.

While your project probably does not entail the volume and head of water that is being measured at Boulder Canyon, it is nevertheless, important that your measurements of flow and liquid level be accurately made by reliable equipment.

Write for complete information on the application of Bailey Meters to your problem. MU-19

BAILEY METER • COMPANY •
1072 Ivanhoe Road, Cleveland, Ohio
BAILEY METER COMPANY LTD., MONTREAL



GASKET AND FORM
The Perfected Method for Making SEWER PIPE JOINTS OF CEMENT

- No jute used—gasket centers spigot.
- Definite space in each joint for cement.
- Form confines cement-grout to lower portion of joint.
- Particularly advantageous in water-bearing trenches.
- Infiltration minimized.

L. A. WESTON **Adams, Mass.**

Complete equipment for Filtration Softening and all other kinds of

Water Purification
PLANTS

Dry Chemical Feeders—Swimming Pool Filters

Consult us any time—no obligations.

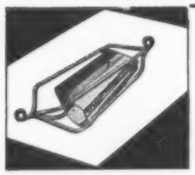
E. W. BACHARACH & CO.
Rialto Bldg., Kansas City, Mo.

EDSON'S NEW HAND PUMP

Smallest Diaphragm Pump Made, 2" Suction Open Discharge. Capacity 1400 G.P.H. Weight 50 lbs.

THE EDSON CORP'N
49 "D" Street
So. Boston, Mass.
NEW YORK: 142 Ashland Pl., Brooklyn
CHICAGO: 1061 Peoples Gas Building

Catalog "T" Gives Full Data, Also Edson Hand and Power Pumps, Suction Hose and Pump Accessories



COMPLETE SEWER CLEANING EQUIPMENT

If you need a sewer cleaning machine, sewer rods or sewer cleaning tools, don't fail to investigate our complete line before buying. Machines sold or leased. Sewer rods and hand tools sent on free trial.

Write for Catalog

W. H. STEWART
Syracuse, N. Y. P. O. Box 767
Jacksonville, Fla. P. O. Box 581
779 Argyle Road, Windsor, Ont., Canada

WITH THE MANUFACTURERS

Allis-Chalmers Names Binder For New Post

● H. P. Binder, until now Sales Engineer, has been appointed Assistant Manager of the Centrifugal Pump Division of the Allis-Chalmers Mfg. Company.

Mr. Binder, a graduate of Purdue University, was selected to enter the Allis-Chalmers Graduate Training Course in 1911. In 1912 he entered the Hydraulic Engineering Department where he served until 1917, at which time he joined the 9th Field Artillery of the regular army. At the conclusion of the war he resigned with the rank of Captain, and returned to Allis-Chalmers in 1919.

Pennsylvania Salt to Build $2,000,000 Plant

● The Pennsylvania Salt Manufacturing Co. has recently purchased 50 acres on the Delaware River at Cornwells Heights, as a site for a new $2,000,000 plant. Cornwells Heights immediately adjoins the northeast boundary of Philadelphia at the upper end of Torresdale.

The company recently sold its 62-acre property in Philadephia at a considerable profit, after occupying the old site for the past 72 years. The new site will provide increased production facilities for present products and more adequately provide for producing new products.

Executive, accounting, and sales offices will remain in Philadelphia, as at present, in the Widener Building. The company has other plants at Natrona and Easton, Penna., Penn Yan, N. Y., Wyandotte, Michigan, and Tacoma, Washington.

Southern Center

FOR LABORATORY APPARATUS AND CHEMICALS

We carry in stock complete equipment for Water Works or Sewerage Laboratories. Ask for literature.

PHIPPS and BIRD, Inc.
RICHMOND, VA.

PATENTED

Quick Easy Lasting

TAPAX is the surest relief from rattling, banging manhole covers and offers you the simplest solution for noisy covers at a cost of comparatively a few cents an application. It will "stay put" for years. Ask for sample.

TAPAX MFG. CO., INC.
MAMARONECK NEW YORK

"VICTOR"
Filter Cloths — All Kinds

Woven specially for rotary vacuum filters

Cotton and Wool Filter Cloths

Filter Flannels for ALL Purposes

"ACIDPROOF" Cloths woven from plastic resins

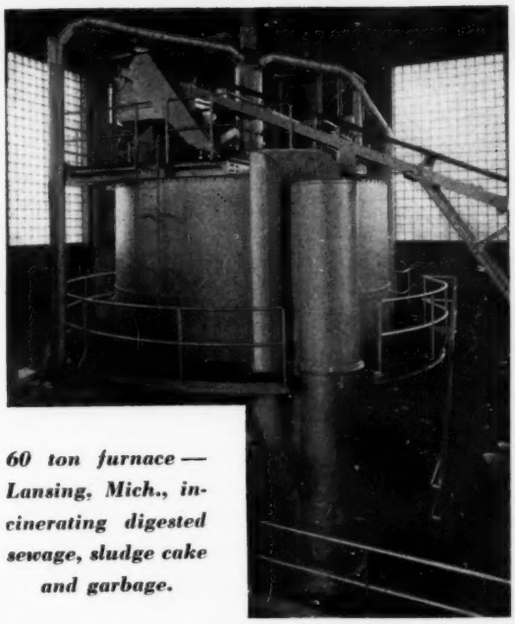
WM. W. STANLEY CO., Inc.
401 BROADWAY, N. Y. C.

WANTED—SALES REPRESENTATIVES

An old, well established company manufacturing Water Treating, Filtration, and Sewage Disposal Equipment is seeking additional representatives in all territories in the U. S. State age, experience, previous connections, and other accounts. Address Box 201, Water Works & Sewerage, 330 So. Wells St., Chicago, Ill.

MULTI-ZONE FURNACES . . .

For Incineration of SEWAGE SLUDGE, SCREENINGS and GROUND GARBAGE



60 ton furnace — Lansing, Mich., incinerating digested sewage, sludge cake and garbage.

● *OPERATION IS WITHOUT AUXILIARY FUEL — ODORLESS!*

Separate drying and incinerating zones. Flexible and automatic control of temperatures. All gases completely deodorized. Residue uniform, inert, non-offensive ash. Operating results positive and low in cost.

MULTI-ZONE FURNACES embody greatly improved principles of multiple hearth furnace operation.

Installations at—

Milwaukee, Wis.	Rutherford, N. J.
Lansing, Mich.	Niagara Falls, N. Y.
Raritan, N. J.	Wisconsin Rapids, Wis.

UNDERPINNING & FOUNDATION CO.
INCORPORATED
155 EAST 44th ST. NEW YORK CITY

Today—Simplex Sand Expansion Indicators are insuring wash water savings and greater efficiency of filtration in large and small—new and old—plants.

In plants whose capacities are as low as 1 m.g.d. and as great as 30 m.g.d. SIMPLEX SAND EXPANSION INDICATORS are proving their worth as an aid in securing proper filter washing. Longer filter runs and reduction in wash water usage are resulting in noteworthy savings. Let us show *you* how this inexpensive device will help you in reducing *your* operating costs.

●

Write for Data

SIMPLEX VALVE & METER CO.

6743 UPLAND STREET • PHILADELPHIA, PA.

WINTER means SHATTERED MAINS so use STEEL PIPE for "Shatter-Proof" Lines

There will be many costly breaks in present lines this winter—but you can avoid future trouble by using "shatter-proof" STEEL PIPE. Because it has extreme ductility, flexibility and high tensile strength, STEEL PIPE is not subject to fractures caused by water hammer and vibration. When STEEL PIPE is Lined and Coated-and-Wrapped by the HILL-HUBBELL "factory applied" Process you have a trouble-free "shatter-proof" line.

Make your plans to attend the 60th Annual Meeting of the American Water Works Association, Kansas City, Mo., the week of April 21st, 1940.

Laying 8⅝" O.D. "Shatter-Proof" STEEL PIPE, WILLIAMSON, N. Y.

GENERAL PAINT CORPORATION
HILL, HUBBELL & CO. • Division • Cleveland, Ohio
• EXPORT OFFICE SAN FRANCISCO, CALIFORNIA, U. S. A. •

MEETINGS SCHEDULED

Feb. 14—Portland, Maine
Maine Water Utilities Association (10:00 A.M.). Secretary, Earle A. Tarr, Winthrop, Me.

Feb. 15—Boston, Mass. (Statler Hotel)
New England Water Works Association. Secretary, Frank J. Gifford, Statler Bldg., Boston, Mass.

Feb. 19-23—College Station, Texas (A. & M. College)
Texas Water Works & Sewage Short School. Secretary, V. M. Ehlers, State Dept. of Health, Austin, Tex.

Mar. 4-8—Detroit, Mich.
American Society of Testing Materials. Sec.-Treas., C. L. Warwick, 260 So. Broad Street, Philadelphia, Pa.

Mar. 18-20—Birmingham, Ala. (Thomas Jefferson Hotel)
Southeastern Section A.W.W.A. Sec.-Treas., B. P. Rice, Room 425, State Office Bldg., Columbia, S. C.

Mar. 20-22—Trenton, N. J. (Hotel Stacey Trent)
New Jersey Sewage Works Association, (Silver Anniversary). Sec.-Treas., Paul Molitor, Jr., P. O. Box 374, Morristown, N. J.

Mar. 21—Boston, Mass. (Statler Hotel)
New England Water Works Association. Secretary, Frank J. Gifford, Statler Bldg., Boston, Mass.

Mar. 27-29—London, Ont. (Hotel London)
Canadian Section A.W.W.A. Secretary, A. E. Berry, Ontario Dept. of Health, Toronto, Ont.

Apr. 4-5—West Lafayette, Ind. (Purdue University)
Indiana Section A.W.W.A. Secretary, H. G. Horstman, 603 Traction Bldg., Indianapolis, Ind.

Apr. 5-6—Miles City, Mont. (New Milligan Hotel)
Montana Section A.W.W.A. Secretary, H. B. Foote, State Board of Health, Helena, Mont.

Apr. 8-9—Santa Catalina Island, Calif.
California Sewage Works Association. Secretary, Wm. T. Ingram, Box 111, Stockton, Calif.

Apr. 10—Boothbay Harbor, Maine
Maine Water Utilities Association. Sec.-Treas., Earle A. Tarr, Winthrop, Me.

Apr. 15-17—Fayetteville, Ark. (Engineering Hall, Univ. of Arkansas)
Arkansas Water & Sewage Conference. Secretary, Harrison Hale, 114 Chemist Bldg., Fayetteville, Ark.

Apr. 16—Middletown, Conn. (Higgins' Inn & Restaurant)
New England Sewage Works Association. Sec.-Treas., LeRoy W. Van Kleeck, State Dept. Health, Hartford, Conn.

Apr. 21-25—Kansas City, Mo. (Headquarters Hotels—The Phillips, The President and The Muehlebach)
American Water Works Association Annual Convention. Secretary, Harry E. Jordan, 22 East 40th St., New York City, N. Y.

May 8—Portland, Ore. (Portland Hotel)
Pacific Northwest Sewage Works Ass'n. (Annual Meeting) Sec.-Treas. Fred Merryfield, Oregon State College, Corvallis.

May 9-11—Portland, Ore. (Portland Hotel)
Pacific Northwest Section A.W.W.A. Secretary, Fred Merryfield, Oregon State College, Corvallis, Oregon.

May 9-10—Akron, Ohio (Mayflower Hotel)
Ohio Section A.W.W.A. Secretary, T. R. Lathrop, State Dept. of Health, Columbus, Ohio.

May 16-17—Salisbury, Md. (Wicomico Hotel)
Maryland-Delaware Water & Sewerage Associations. Secretary, A. W. Blohm, 2411 North Charles St., Baltimore, Md.

May 16-18—(Place not selected)
Florida Section A.W.W.A. Secretary, A. P. Black, University of Florida, Gainesville, Fla.

May 22-24—Chicago, Ill. (Congress Hotel)
Illinois Section A.W.W.A. Secretary, H. E. Hudson, Jr., 6843 Oglesby Ave., Chicago, Ill.

May 16-17—Salisbury, Md. (Wicomico Hotel)
Maryland-Delaware Water & Sewerage Association. Secretary, A. W. Blohm, 2411 North Charles St., Baltimore, Md.

June 6-7—Ithaca, N. Y. (Hotel Ithaca)
New York Section A.W.W.A. (Spring Meeting). Secretary, R. K. Blanchard, 50 West 50th St., New York, N. Y.

June 12—POLAND SPRING, ME.
Maine Water Utilities Association. Sec.-Treas., Earle A. Tarr, Winthrop, Me.

June 24-28—ATLANTIC CITY, N. J.
American Society of Testing Materials (Annual Meeting). Sec.-Treas., C. L. Warwick, 260 So. Broad St., Philadelphia, Pa.

June 24-26—STATE COLLEGE, PA. (Nittany Lion Inn & Dormitories)
Pennsylvania Water Works Operators' Association. Annual Convention. Sec.-Treas., I. M. Glace, Consulting Engineer, 22 So. 22nd St., Harrisburg, Pa.

June 26-28—STATE COLLEGE, PA. (Nittany Lion Inn & Dormitories)
Pennsylvania Sewage Works Association. Sec.-Treas., L. D. Matter, Distr. Engr., Kirby Health Center, Wilkes Barre, Pa.

Sept. 24-27—NEW YORK, N. Y. (Commodore Hotel)
New England Water Works Association. (59th Annual Convention). Secretary, Frank J. Gifford, 613 Statler Bldg., Boston, Mass.

Sept. 26-27—WILMINGTON, DEL.
Four States Section A.W.W.A. Secy.-Treas., Carl A. Hechmer, Washington Suburban Sanitary District, Hyattsville, Md.

Oct. 14-17—TULSA, OKLA.
Southwest Section A.W.W.A. Secretary, Lewis A. Quigley, 3320 W. Berry Street, Fort Worth, Texas.

Oct. 16-18—ATLANTIC CITY, N. Y. (Haddon Hall)
Pennsylvania Water Works Association. (45th Annual Meeting.) Secretary, F. Herbert Snow, 507 Telegraph Bldg., Harrisburg, Pa.

Nov. 7-8—ST. PAUL, MINN. (The Hotel Lowry)
Minnesota Section A.W.W.A. Sec.-Treas., R. M. Finch, W. & T. Co., 416 Flour Exchange, Minneapolis, Minn.

LITERATURE AND CATALOGS

"Multi-Zone Furnaces"—of the multiple-hearth type for sewage sludge and screenings, are the subject of a new brochure from Underpinning and Foundation Co., Inc., of New York City. The bulletin emphasizes the fact that a fundamental change has taken place in the design and operation of the modern sewage treatment plant. For instance, with incineration of solids and the concurrent destruction of odorous gases, modern plants may be located much more economically at closer proximity to the origin of the sewage. Thereby, the added cost for incineration and odorless operation is returned sometimes many-fold in savings in initial construction costs and through improved functioning of the treatment process, due to non-septic sewage. Installations of "Multi-Zone" furnaces at Niagara Falls, Milwaukee and Lansing, Mich., are pictured and described. For a copy of "The Multi-Zone Furnace" write Underpinning and Foundation Co., Inc., 155 East 44th St., New York City.

"Ringstyle Meter Valves and Couplings"—are described and illustrated in a new folder from Ford Meter Box Co. The new Ringstyle Valve and Couplings are made of red-brass and the finest valve bronze. Similar valves have long been supplied on the well known Ford Yokes and "Coppersetters". The valve takes the place of the ordinary inverted ground-key and a bent meter coupling. Thus their use eliminates one coupling and one joint. The valve is attached direct to the meter, with the tee-head on top, so that the key may be readily turned from above. The Ringstyle Coupling takes the place of an ordinary bent meter coupling and an iron pipe coupling, saving again the needless joint between the two. An illustration in the folder pictures a meter

Disposal Plant, Scotia, N. Y.

Naturally, we have been pleased to find so many users enthusiastic about our Chemical Feeders. Recently, an advertisement that listed cities which had awarded sewage vacuum-filter contracts between March first and August first 1939 caught our eye. Just for fun, we checked our records to see how many of those same cities had purchased Ferr-O-Feeders for use with their rotary vacuum filters. This is the summary:

CITY	MAKE OF FILTER	Did they buy Ferr-O-Feeders for sludge dewatering plant?
Ashland, Ohio	Conkey (Goslin Birmingham)	Yes
Cortland, N. Y.	Conkey	Yes
Hackensack, N. J.	Conkey	Yes
Liberty, N. Y.	Conkey	Yes
Midland, Mich.	Conkey	Yes
Wisc. Rapids, Wisc.	Conkey	Yes
Peru, Ind.	Eimco Corp.	Yes
Marshalltown, Iowa	Eimco	No
Piqua, Ohio	Eimco	Yes
Stevens Pt., Wis.	Eimco	Yes
Watervliet, N. Y.	Eimco	Yes
Wausau, Wis.	Eimco	Yes
Manitowoc, Wisc.	Eimco	Yes
Troy, Ohio	Oliver United Co.	Yes
New Haven, Conn.	.....	No
Springfield, Mass.	.....	No
Green Haven, N. Y.	Filt. Engrs.	Yes

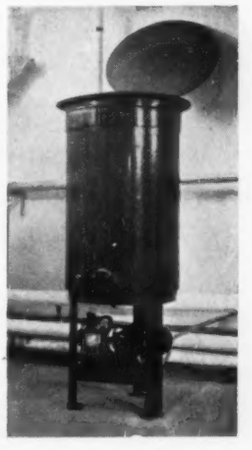
14 out of 17 bought Ferr-O-Feeders! If the old slide rule still works that is 82.3%.

A NEW SIGHT FEEDER

If you'll pardon the intimate reference, this sight feeder reminds us of the argument the salesman used to sell the new mother "cellophane panties" for her baby: "Put those on the baby, Lady, and you'll SEE what's going on!"

The base is of acid resisting bakelite; the dome is unbreakable glassite—to clean, simply unscrew the dome, wipe it out, and replace. These new units are furnished free with new Chlor-O-Feeders—or you can buy them at $2.00 each for feeders you already have.

Handy Sight Feeder



Ferric Tank and Ferr-O-Feeder used with Oliver United Filter at Scotia, N. Y.

FOR THE REST OF THE NEWS—particularly about chemical feeders for your own requirements, address—

% PROPORTIONEERS, INC. %
9 N. CODDING STREET, PROVIDENCE, R. I.

What YOU GET WITH

GRAVER

Water Treating Equipment

• EFFICIENCY • DEPENDABILITY
• PERFECTLY TREATED WATER
• LOWER MAINTENANCE COSTS

For full particulars on equipment to meet your requirements, write Graver Tank & Mfg. Co., Inc., Dept. 3, East Chicago, Ind.

GRAVER TANK & MFG. CO., INC.

OVER THREE QUARTERS OF A CENTURY OF DEPENDABLE SERVICE

NEW YORK CATASAUQUA, PA. EAST CHICAGO, IND. CHICAGO TULSA

CABLE ADDRESS—GRAYANK

Don't Let Mottled Teeth Handicap Your Children

DON'T LET children in your community become handicapped by mottled teeth caused by fluorine in the drinking water. Your water supply may be one of the many all over the country containing this dangerous element in quantities that will mottle or even completely destroy tooth enamel.

Typical case of mottled tooth enamel

LIFETIME HANDICAP

Try to place yourself in the position of a young man or woman whose teeth are marred by ugly chalky, brown or even black patches. You would always be extremely conscious of such a disfiguration. It would be a constant handicap to both your social and professional advancement.

But children in your community need not face such a handicap. How fluorine can be effectively and economically removed from water with Fluorex Purifiers is told in Bulletin 2500-A. Write for your copy.

INTERNATIONAL FILTER CO.
325 W. 25TH PLACE, CHICAGO, ILL.

INFILCO

in a pit, set with these neat fittings as one piece connections between meter and the two copper tubing risers. These new fittings are provided with hard leather gaskets. For a copy of the "Ringstyle" folder write Ford Meter Box Co., Wabash, Indiana.

"An Approved Oil and Gasoline Separator"—is the "Solus" which is described and illustrated in a small booklet from The Central Foundry Co. Emphasis is given the fact that this separator is the only one on the market approved by the Fire Underwriters' Laboratories as a unit that will give assured protection against sewer explosions by a positive prevention of oil and gasoline extrance from garages, clothes cleaning establishments and the like. The "Solus" and its unique working features are clearly described with the aid of a phantom illustration. One can readily see that if every hazardous sewer connection was "Solus" trapped there could be no discharge of flammable materials into the main sewer. For permanence the "Solus" is constructed of cast iron; for assured trapping and guarantee against neglect, a valve closes off the drain until the accumulation of excess floating fluid is removed. For a copy of "The Solus Oil and Gasoline Separator," write The Central Foundry Co., 386 4th Ave., New York City.

"Aids in Selecting the Right Centrifugal Pump"—constitute an important part of a new Fairbanks-Morse bulletin of 24 pages of text and helpful illustrations accompanying the discussion of the meaning of items which should be covered in "Pump Specifications". Thereafter follows a highly useful three pages of ready reference tables for rapidly arriving at recommended design, size of pump, and motor rating for various required delivery rates against heads of 30 to 300 ft. The tables cover pumps operating at speeds of 860, 1150 and 1750 r.p.m. A listing of typical specifications for F.M. Pumps is followed by tables of useful data in computing friction heads through pipes and fittings. For a copy of the new Bulletin 5810 D. write, Fairbanks-More and Co., 600 South Michigan Ave., Chicago, Ill.

"Link-Belt Non-Clogging Spray Nozzles" are presented in a new folder from Link-Belt Co. These nozzles consist of polished bronze deflector fins for attaching by U-bolts to a pipe. The liquid from within the pipe discharges through a round hole through the pipe wall to impinge at high velocity against the curved polished fin. A fan-shaped high velocity spray results. These so-called nozzles are employed for a variety of uses such as cleaning traveling screens, lawn spraying, road sprinkling, etc. One use for such nozzles, that we can think of, is that of a cross-tank installation for sweeping floating materials from settling tanks into the end zone for more ready removal. For a copy of descriptive and suggestive Folder No. 1632, write Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.

"Pipe Lines"—being published periodically by the Clay Sewer Pipe Association, Inc., has appeared in its second issue; and, to our thinking, in vastly improved form over the first issue reviewed in our December issue. Issue No. 2 has been enlarged to eight pages, several of which are devoted to an interesting history of early City Planning and the use of clay sewer pipes in the Nation's Capital, dating back before the War of 1812. A discussion of "Head Losses at Sewer Manholes," "Improved Manhole Design," "Fittings for Sewer Connections," constitutes the type of information which engineers and construction men like to find in such publications. Those wishing to receive regular mailings have only to request such of the Clay Sewer Pipe Association, Inc., Oliver Bldg., Pittsburgh, Pa.

"The Pollard News"—comes to us at intervals from Joseph G. Pollard Co., Inc., which are distributors of many items of utility and maintenance equipment needed by water and sewage operators. In the current issue illustrated and described are leak locating instruments, pipe cutters for cutting cast-iron pipes 4 to 12 inches in diameter, caulking tools, sewer cleaning machines, hydrant thawing outfits, hydrant flow and pressure gauges, and several items of everyday interest. If interested in such equipment as leak locating and thawing devices, sewer maintenance equipment, etc., get on the "Pollard News" list. Address Joseph G. Pollard Co., Inc., 142 Ashland Place, Brooklyn, N. Y.

"Chemical Mixers and Feeders" is the caption of a new bulletin from International Filter Co., which features "Infilco" Mixers and Feeders for the uniform preparation and feeding of all types of suspensions of chemicals in water conditioning and sewage treatment. This type of equipment employs vertical agitation, to assure uniformity, and provides the most accurate means available for feeding a suspension or solution. One of the advantages of such feeders lies in the fact that two chemicals may be prepared and fed together. Another advantage is that the discharge can be divided into two variable portions for use at two different points. These feeders, equipped with manual variators for changing the dosage, are also available with automatic proportioners for varying feed in proportion to the flow of liquid undergoing treatment. For a copy of Bulletin No. 350-A write International Filter Co., 325 W. 25th Place, Chicago, Ill.

"ALCO Diesels and Gas Engines"—are described in a new bulletin from the Diesel Division of American Locomotive Co. These engines have been manufactured by The McIntosh and Seymour Corp. since 1930, this company having become an ALCO unit. At present the range of ratings offered run from 400 to 1200 h.p. and these engines are offered for service as either Diesel or gas engines. For a copy of "ALCO Engines," write American Locomotive Co., 30 Church St., New York City.

"Davis First Aid Kits" are covered in a bulletin from Davis Emergency Equipment Company of New York. These First Aid Kits have made a name for themselves in industry, but are apparently little known in the water and sewage field. They feature the interchangeable unit system, starting with the small 10 Unit Kit (7½"x4½"x2 7/16") and going to the largest 60 Unit Kit. The 10 Unit Kit provides 5 bandage compresses; 10 Ammonia inhalants; Tannoid for burns; Tourniquet and Forceps; 10 Isodine Swabs; 1 Eye Dressing. When used, replacement units are inserted, the listing of such units being given. The case, of 20 gage steel, is rubber gasketed for dust and moisture tightness. If interested in a *real* First Aid Kit, ask for Bulletin 132—Davis Emergency Equipment Co., Inc., 55 VanDam St., New York.

"Water Metering and Water Estimating"—is a booklet suitable for supplying water consumers and others who may be interested in the "why" of water meters. "Water Metering and Water Estimating," by C. M. McCord, Director of Water, Memphis, Tenn., for the primary purpose of education of water consumers on what makes the meter go, and, more importantly, why water meters have a tendency to run too slow rather than too fast. The closing paragraph states—"You are in greater danger of being struck by lightning than you are of being overcharged by a fast water meter." The booklet is offered to water companies and water departments in quantities at a nominal charge by the publishers—The Ambassador Co., Temple, Texas, which is ready to submit sample copies with quotations.

Economy Dictates

DOW

Sludge Conditioning

FERRIC

Sewage Coagulation

CHLORIDE

Water Purification

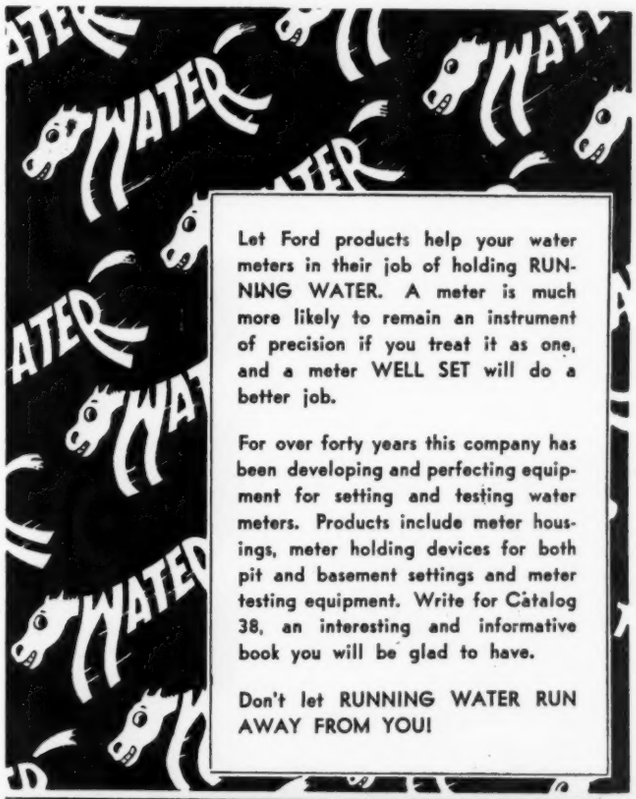
35-45% Solution — **Shipped in Tank Cars**

60% Crystals — **Packed in 300 or 500 lb. Barrels**

For quotations and complete technical information, write today.

THE DOW CHEMICAL COMPANY

MIDLAND, MICHIGAN


WATER
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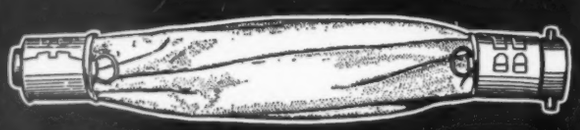

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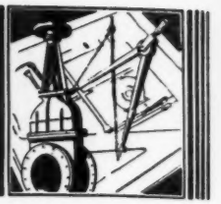

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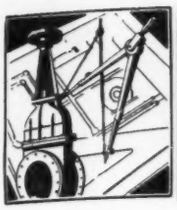

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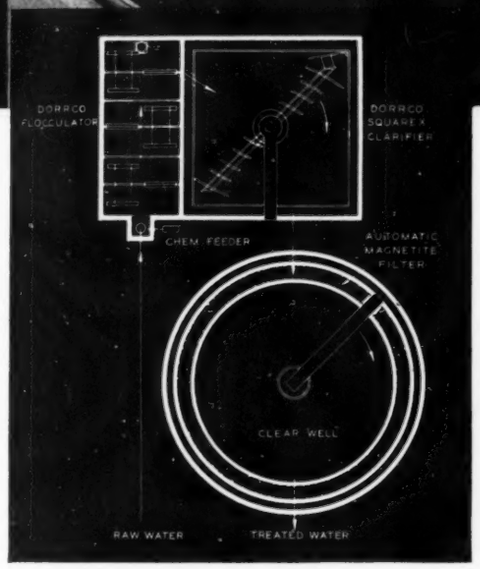

Treatment flowsheet at Escanaba.

Water purification plant of Escanaba Paper Company. Feeders, Flocculator and Clarifier in background; Magnetite Filter and clear well in foreground.

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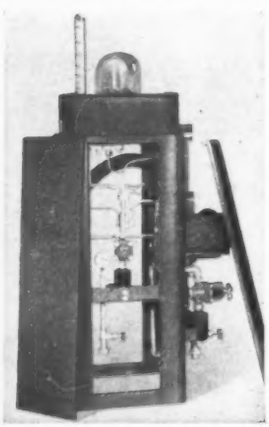

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